DRAFT PIGG RIVER AND OLD WOMANS CREEK WATERSHEDS TMDL

IMPLEMENTATION PLAN

Submitted to:

The Stakeholders of the Pigg River Watershed

Prepared by:

Pigg River IP Steering Committee

In Cooperation With:

Virginia Tech Department of Biological Systems Engineering and Center for Watershed Studies,

Virginia Department of Environmental Quality,

and

Virginia Department of Conservation and Recreation

February 12, 2009

Biological Systems Engineering

VirginiaTech Invent the Future

CENTER for WATERSHED STUDIES at VIRGINIA TECH

VT-BSE DOCUMENT NO. 2009-0002

Project Personnel

Resource Team

Mary Dail	Virginia Department of Environmental Quality
Paula Nash	Virginia Department of Environmental Quality
Megan Sommers Bascone	Virginia Department of Conservation and Recreation
Krystal Coxon	Virginia Department of Conservation and Recreation
Karen Kline	Virginia Tech Department of Biological Systems Engineering
Julie Jesiek	Virginia Tech Department of Biological Systems Engineering

Steering Committee and Working Group Rosters

Participant	Affiliation	Steering Committee	Working Group Participation	
			Residential	Agricultural
Preston Belcher	Farmer			•
Jim Bier	Citizen		•	
Adam Carter	Virginia Department of Health	•	•	
Beverly Cox	Virginia Cooperative Extension	•		
David Cundiff	Farmer			•
Tony Goff	Blue Ridge SWCD, Ag. Working Group Rep.	•	•	•
Garrett Hodges	Farmer			•
Ned Hudson	Farmer			•
Bill Huff	Citizen			•
Katherine Jordan	Ferrum College		•	•
Jackie Lindsey	Virginia Roanoke River Basin Advisory Committee		•	
John Lindsey	Virginia Roanoke River Basin Advisory Committee		•	
Carol Love	Creek Freak Paddlers of Franklin County		•	
Scott Martin	Franklin County		•	
P.W. Morgan	Blue Ridge SWCD	•		•
John P. Myers	Pittsylvania SWCD, Ag. Working Group Rep.	•		•
Jack O'Connell	USDA/National Resources Conservation Service	•		•
Doug Phillips	Southern Rural Community Assistance Project	•	•	•
Bill Reidenbach	Citizen		•	
Roger Seale	Blue Ridge SWCD		•	

Participant	Affiliation	Steering Committee	Working Group Participation	
			Residential	Agricultural
Robin Shields	Pittsylvania-Danville Health Dept	•	•	
Dan Sleeper	Pittsylvania County Administrator			•
Kathy B. Smith	Blue Ridge SWCD	•	•	•
Morris Stephenson	The Franklin News-Post		•	
Michael L. Tabor	Blue Ridge SWCD	•		•
David Vogelsong	Franklin County	•		
Kitty (Katherine) Wasicko	Leesville Lake Association	•		
Dr. William J. Wasicko	Leesville Lake Association	•		
Brian Watson	Virginia Department of Game and Inland Fisheries			•
Jared Webb	Citizen, Residential Working Group Representative	•	•	
Eddie Wells	Roanoke Valley- Alleghany Regional Commission	•		
Raymond Williams	Creek Freak Paddlers of Franklin County		•	
Nathan Wright	Town of Rocky Mount		•	

For additional information, please contact:

Virginia Department of Environmental Quality (VADEQ)
Blue Ridge Regional Office, Roanoke: Mary Dail, (540) 562-6715
Virginia Department of Conservation and Recreation (VADCR)
Richmond Office: Megan Sommers Bascone, (804) 225-3039

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Introduction

This document serves as the Total Maximum Daily Load (TMDL) implementation plan (IP) for the Pigg River and Old Womans Creek watersheds in Franklin, Henry and Pittsylvania counties Virginia (Figure ES.1). The purpose of this IP is to address the bacteria impairments in the Pigg River and Old Womans Creek watersheds. TMDLs were developed for five of the stream segments (Story Creek, Upper Pigg River, Snow Creek, Leesville Lake-Pigg River, and Old Womans Creek) in 2006 and approved by U.S. Environmental Protection Agency (USEPA). Three additional segments, Big Chestnut Creek, Harpen Creek, and Tomahawk Creek, were listed as impaired after the TMDL study completed (Table ES.1). Thus, TMDLs have not been developed for these three segments; however, since they are within the Pigg River watershed, this IP includes practices that address those impairments.

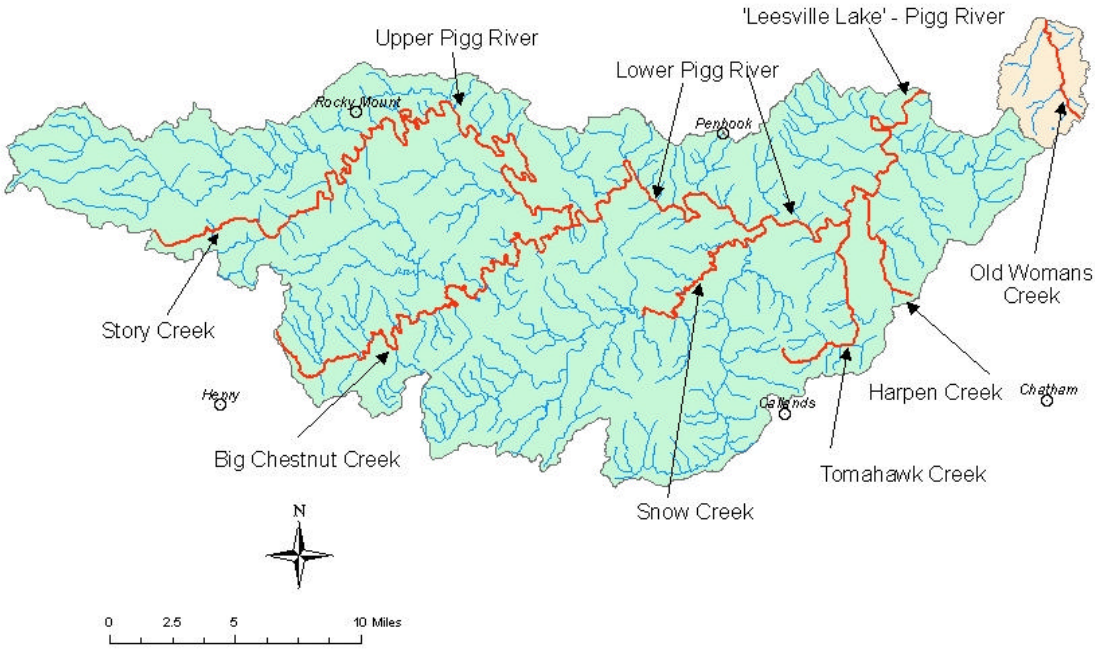

Figure ES.1. Impaired segments in the Pigg River and Old Womans Creek watersheds.

Table ES.1. Pigg River and Old Womans Creek impaired segments

Stream	Original Listing Date	Instantaneous Bacteria Criterion at Time of Listing
Targeted in 2006 TMDL		
Story Creek (VAW-L14R-02)	1996	1,000 cfu/100 mL (Fecal Coliform)
Upper Pigg River (VAW-L14R-01)	1996	
Leesville Lake-Pigg River (VAW-L13L-01)	1998	

Snow Creek (VAW-L17R-01)	2002	
Old Womans Creek (VAW-L13R-01)	2002	
Listed as impaired since the 2006 TMDL		
Big Chestnut Creek (VAW-L15R-01)	2004	235 cfu/100 mL (*E. coli*)
Harpen Creek (VAW-L18R-01)	2006	
Tomahawk Creek (VAW-L18R-01)	2006	

Developing the IP is the step in the TMDL process that specifies how pollutant reductions called for in the TMDL study will be achieved. The TMDL IP is a requirement of Virginia's 1997 Water Quality Monitoring, Information, and Restoration Act or WQMIRA (§62.1-44.19:4 through 19:8 of the Code of Virginia).

Review of the Pigg River and Old Womans Creek TMDL Development

The Pigg River (PR) and Old Womans Creek (OWC) watersheds (392 and 13 mi^2, respectively) lie in portions of Virginia's Franklin, Henry, and Pittsylvania counties. PR and OWC discharge into Leesville Lake. Leesville Lake is on the Roanoke River, which flows south into North Carolina and eventually discharges to the Albemarle Sound. Snow Creek, Story Creek, Big Chestnut Creek, Harpen Creek, and Tomahawk Creek are all tributaries to the Pigg River. Approximately 72% of the watershed is forested and 26% is agricultural. Residential and commercial land uses account for less than 2% of the watershed.

Potential sources of bacteria considered during TMDL development included both point source and nonpoint source (NPS) contributions. Point sources of bacteria in the PR and OWC watersheds include all municipal and industrial plants that treat human waste and are issued individual permits by the Virginia Department of Environmental Quality (VADEQ), as well as any private residences that fall under Virginia Pollutant Discharge Elimination System (VPDES) general permits. NPSs of bacteria include failing septic systems and straight pipes, livestock (including manure application loads), wildlife, and domestic pets.

Various pollutant reduction scenarios were evaluated to meet the state water quality standards for *E. coli*, the 30-day geometric mean target (126 cfu/100 mL) and the single sample maximum (235 cfu/100 mL), with zero violations (a requirement of the TMDL). An implicit MOS was used in these bacteria TMDLs by using conservative estimations of all factors that would affect bacteria loadings in the watershed (e.g., animal numbers, production rates, contributions to the stream). These factors were estimated in such a way as to represent the highest amount of bacteria from each source in the watershed. In addition to anthropogenic source reductions, the

PR and OWC TMDLs call for reductions from wildlife sources. The final reduction scenarios from each watershed are shown in Table ES.2.

ES.2. Final pollutant source reduction scenarios for the Pigg River and Old Womans Creek watersheds.

Impaired Watershed	Required Fecal Coliform Loading Reductions to Meet the *E. coli* Standards,%					
	Cattle DD*	Loads from Cropland	Loads from Pasture	Wildlife DD*	Straight Pipes	Loads from Residential
Snow Creek	60	0	95	0	100	95
Story Creek	100	0	85	45	100	75
Upper Pigg River†	100	0	95	5	100	90
Leesville Lake – Pigg River‡	100	0	95	30	100	90
Old Womans Creek	100	0	90	67	n/a	85

*DD = direct deposit
†Includes reductions for Story Creek applied to the Story Creek portion of the watershed
‡Includes reductions for Story Creek, Snow Creek, and Upper Pigg River applied to the appropriate portions of the watershed
n/a = not applicable; no straight pipes exist in the Old Womans Creek watershed

Public Participation

An essential step in developing a TMDL IP and implementing that plan is input from, and engagement of, a broad range of stakeholders (individuals, agencies, organizations, and businesses) with interest in and familiarity with local water quality conditions and needs. Public participation facilitates dialogue between local stakeholders and government agencies (the primary resource base for installing incentive-based NPS pollution control measures).

The personnel involved in developing this IP included a Resource Team, a Steering Committee, and Working Groups that include local stakeholders. The Resource Team included staff with VADEQ, the Virginia Department of Conservation and Recreation (VADCR), and faculty with the Center for Watershed Studies in the Biological Systems Engineering Department at Virginia Tech. The Working Groups, two focused on agricultural issues and the other on residential and governmental issues, and the Steering Committee were comprised of watershed stakeholders. Input from stakeholders was solicited through a series of meetings and via electronic means (e-mail and the internet).

Implementation Actions

Potential control measures, their costs, and pollutant removal effectiveness estimates were identified through a review of the PR and OWC TMDL, through input from the TMDL IP Working Groups and Steering Committee, from a literature review, and from modeling. Because the PR

and OWC watersheds contain a combination of agricultural and residential land uses, implementation actions to address the required pollutant reductions include of a variety of control measures to address each pollutant source.

The problems/pollutant sources that were identified in the PR and OWC TMDL study include unrestricted livestock access to streams, lack of streamside buffer/forest, agricultural runoff, residential runoff, and straight pipes. As part of the IP development process, stakeholders (through the PR and OWC TMDL IP Working Groups and Steering Committee) identified potential actions and strategies to address each problem/source. The quantity of corrective measures or implementation actions needed to meet the source load reductions called for in the PR and OWC TMDL (excluding reductions associated with wildlife sources) was determined through spatial analysis and the same models used in the TMDL study. The estimated type and quantity of corrective measures needed and the estimated costs for each measure are summarized in Tables ES.3 and ES.4.

ES.3. Estimated agricultural corrective measures required to achieve bacteria TMDLs in the Pigg River and Old Womans Creek watersheds.

Practice	Unit	Quantity	Cost/ Unit	Total Cost
Fencing with off-stream water (SL-6 Grazing Land Protection)	system	395	$20,000	$7,900,000
Fencing (WP-2T Stream Protection)	mile	55	$13,000	$715,000
Reforestation of Pasture	acre	649	$1,355	$879,395
Improved Pasture Management	acre	48,286	$107	$5,166,602
Loose Cattle Housing Facility	animal	9,686	$1,192	$11,545,712
Bioretention Filter	acre	156	$10,000	$1,560,000
Technical Assistance	person-years	20	$50,000	$1,000,000
Total				**$28,766,709**

ES.4. Estimated residential corrective measures required to achieve bacteria TMDLs in the Pigg River and Old Womans Creek watersheds.

Practice	Estimated no. of systems needed	Cost/system	Total Cost
Replacing Straight Pipes			
Conventional Septic System (with pump)	12	$6,000	$72,000
Alternative Waste Treatment System	2	$20,000	$40,000
Repairing Failing Septic Systems	1,658	$2,000	$3,316,000
Replacing Failing Septic Systems			

Conventional Septic System	291		
without pump	*87*	$3,900	$339,300
with pump	*204*	$6,000	$1,224,000
Alternative Waste Treatment System	123	$15,000	$1,845,000
Residential Pet Waste Education Program	1	$3,750	$3,750
Technical Assistance (person-years)	10	$50,000	$500,000
Total			**$7,340,050**

Measurable Goals and Milestones

Implementation milestones define the portion of implementation actions to be installed within certain time periods or stages. Water quality milestones establish the corresponding improvements in water quality that can be expected as the implementation milestones are met.

The TMDL lists an interim set of Stage 1 goals for bacteria load reductions and will serve as part of the first implementation milestone at the 5-year mark. In addition, the Stage 1 goals for implementation in Pigg River will focus on implementing the Residential Pet Waste Education Program, installing 50% of residential best management practices (BMPs) to address failing septic systems, and installing 50% of agricultural BMPs for improved pasture management. Implementation of Stage 1 control measures is expected to reduce the bacteria loadings from controllable sources so that violations of the single sample maximum *E. coli* criterion (235 cfu/100mL) are less than 10.5%. Local SWCD personnel have already started working with producers in the watersheds to install agricultural BMPs.

The remaining control measures will be installed during the next 5-year period (Stage 2). After installation of all control measures during the first two stages, full maturation of the control measures, full attainment of water quality goals (zero violations of the *E. coli* single sample maximum criterion) and de-listing from the Section 303(d) list will occur by the end of the last 5-year period (Stage 3).

Once the implementation milestones and stages are established, the water quality improvement that should result from achieving each milestone can be predicted. The bacteria violations that result from each implementation milestone were estimated by using the HSPF modeling files that were developed during the TMDL process. The water quality and implementation milestones are summarized together in Figure ES.2.

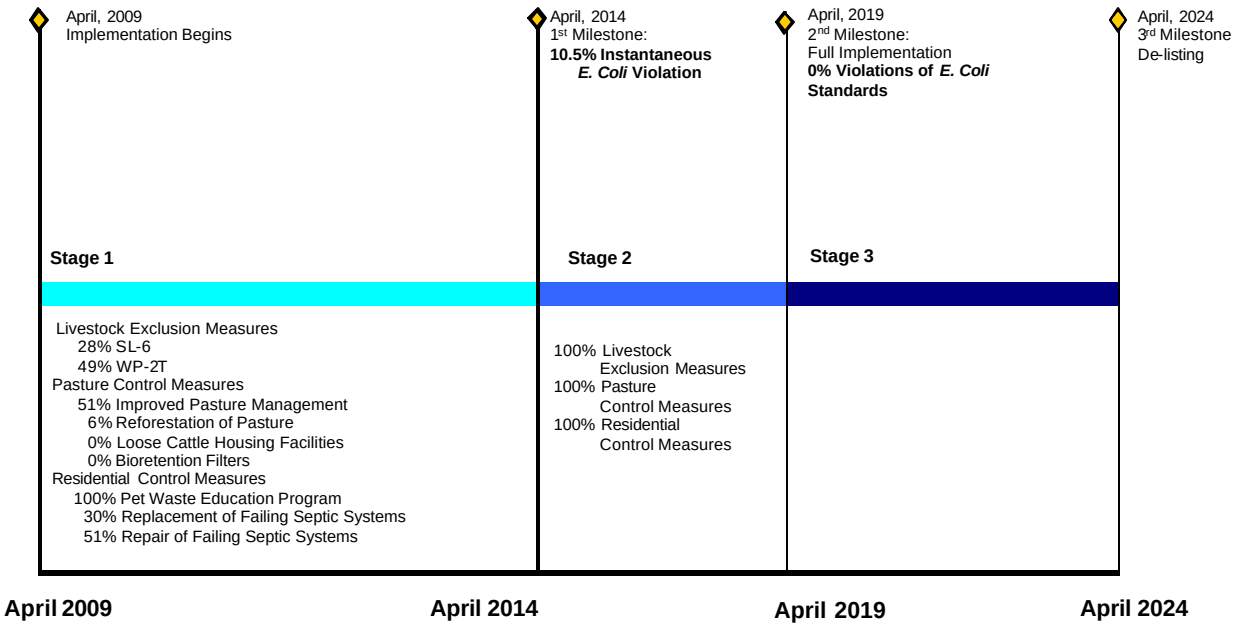

Figure ES.2. Implementation and water quality milestones for the Pigg River and Old Womans Creek watersheds.

Stakeholders' Roles and Responsibilities

Many state and federal agencies have roles and responsibilities in the implementation process. VADEQ is the lead agency in the TMDL process and is providing funding for the development of this IP. U.S. Environmental Protection Agency (USEPA) has the responsibility of overseeing the various programs necessary for the success of the Clean Water Act. The U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) assists private landowners with conserving their soil, water, and other natural resources. VADCR has a lead role in the development of IPs to address correction of NPSs contributing to water quality impairments. VADCR also provides available funding and technical support for the implementation of NPS components of IPs. The Commissioner of Agriculture can issue an emergency corrective action if runoff is likely to endanger public health, animals, fish and aquatic life, public water supply, etc. An emergency order can shut down all or part of an agricultural activity and require specific stewardship measures.

Regional and local government groups work closely with state and federal agencies throughout the TMDL process; these groups possess insights about their regional and local community that may help to ensure the success of TMDL implementation. These stakeholders have knowledge about a community's priorities, how decisions are made locally, and how the watershed's residents interact. Some local government groups involved in the TMDL process are the Blue

Ridge and Pittsylvania Soil and Water Conservation Districts (SWCDs), the Planning District Commissions, the Town of Rocky Mount, and Franklin, Henry and Pittsylvania counties.

While successful implementation depends on stakeholders taking responsibility for their role in the process, the primary role falls on the local groups that are most affected, that is, businesses, community watershed groups, and citizens.

Potential Funding Sources

Potential funding sources available during implementation were identified during plan development. Sources may include:

- Canaan Valley Institute Small Grants Program
- Clean Water State Revolving Fund
- Conservation Reserve Enhancement Program – CREP
- Environmental Quality Incentives Program
- EPA 319 Grant Incremental Funds
- Five Star Restoration Program
- Landowner Incentive Program (Non-Tribal)
- Southeast Rural Community Assistance Project (SER-CAP)
- Virginia Aquatic Resource Trust Fund (VARTF)
- Virginia Agricultural BMP Cost-Share Program
- Virginia Agricultural BMP Loan Program
- Virginia Agricultural BMP Tax Credit Program
- Virginia Environmental Endowment
- Virginia Open Space Lands Preservation Trust Fund

1. INTRODUCTION

1.1. Background

In 1972, the US Congress enacted the Federal Water Pollution Control Act known as the "Clean Water Act" (CWA). The founding objective of that legislation was well defined in its opening paragraph,

"to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."

The legislation covers a range of water quality efforts aimed at reaching this objective. Immediately relevant to this project are the requirements that states develop and promulgate water quality standards for waters within their jurisdictions. In section 303(d) of the Act, the federal government requires states to identify those water bodies not meeting the published water quality standards for any given pollutant. This list is often called the "303(d) list" or the "impaired waters list." Virginia's first impaired waters list was published and reported to the United States Environmental Protection Agency (USEPA) in 1994. Recently, the 303(d) list has been combined with the 305(b) water quality assessment report which describes the overall quality of a state's waters. Virginia publishes and submits this "305(b)/303(d) Integrated Report" to USEPA every two years.

Section 303(d) requires that, if a particular water body is listed as "impaired," the state must develop a "total maximum daily load" for any pollutant that exceeds water quality standards in that water body. The "total maximum daily load" or TMDL is essentially a "water pollution budget." A TMDL study defines the maximum amount of pollutant each source in the watershed can contribute to the water body, so that the water body remains in compliance with applicable water quality standards.

Virginia's 1997 Water Quality Monitoring, Information and Restoration Act states in section 62.1-44.19:7 that the "Board shall develop and implement a plan to achieve fully supporting status for impaired waters." This means that after a TMDL is developed for an impaired water, an Implementation Plan (IP) must be developed and implemented with the goal of meeting the water quality standards for the water body. The purpose of the IP presented in this document is to characterize implementation actions that will achieve the water quality goals in the Pigg River (PR) and Old Womans Creek (OWC) watersheds.

1.2. Designated Use and the Applicable Water Quality Standard

According to 9 VAC 25-260-5 of Virginia's State Water Control Board Water Quality Standards, the term 'water quality standards' means "…provisions of state or federal law which consist of a designated use or uses for the waters of the Commonwealth and water quality criteria for such waters based upon such uses. Water quality standards are to protect the public health or welfare, enhance the quality of water and serve the purposes of the State Water Control Law and the federal Clean Water Act."

The 'Designation of Uses' of all waters in Virginia is defined in the Code of Virginia (9 VAC 25-260-10) (SWCB, 2003):

All state waters are designated for the following uses: recreational uses (e.g. swimming and boating); the propagation and growth of a balanced indigenous population of aquatic life, including game fish which might reasonably be expected to inhabit them; wildlife; and the production of edible and marketable natural resources (e.g., fish and shellfish).

The applicable water quality criteria for fecal bacteria impairments are contained in Section 9 VAC 25-260-170. At the time the stream segments in the PR and OWC watersheds were first placed on the 303(d) list, the criteria for fecal coliform bacteria included two parts: (1) the fecal coliform bacteria count shall not exceed a geometric mean of 200 per 100 mL of water for two or more samples taken over a 30-day period, and (2) the fecal coliform bacteria count shall not exceed 1,000 per 100 mL at any time (single-sample criteria). If the water body exceeds the single sample maximum more than 10% of the time, the water body is classified as impaired and a TMDL must be developed and implemented to bring the water body into compliance with the water quality standard. If the sampling frequency is one sample or less per 30 days, the single-sample criterion is applied; for a greater sampling frequency, the geometric mean criterion is applied. Most of the ambient water quality monitoring conducted by VADEQ is done on a monthly or bimonthly basis. This sampling frequency does not provide the two or more samples within 30 days needed for use of the geometric mean part of the standard. Therefore, VADEQ used the 1,000 per 100 mL part of the standard in the assessment of the fecal coliform bacteria monitoring data.

USEPA had recommended that all states adopt an *Escherichia coli* (*E. coli*) or enterococci standard for fresh water and enterococci criteria for marine waters by 2003. USEPA pursued the states' adoption of these standards because there is a stronger correlation between the concentration of these organisms (*E. coli* and enterococci) and the incidence of gastrointestinal

illness than with fecal coliform. *E. coli* and enterococci indicate the presence of fecal contamination. The adoption of the *E. coli* and enterococci standards has been in effect in Virginia since January 15, 2003. As of that date, the *E. coli* standard (Table 1.1) applies to all freshwater streams in Virginia.

Table 1.1. *E. coli* standard for fresh water outlined in 9 VAC 25-260-170.A.2.

Water Quality Parameter (units)	Geometric Mean[a]	Single Sample Maximum
E. Coli (cfu[b]/100 mL)	126	235

[a]For two or more samples taken during any calendar month.
[b]colony forming units

Prior to June 30, 2008, an interim fecal coliform standard was also applied at any sampling station that had fewer than 12 samples analyzed for *E. coli*. The interim fecal coliform standard stated that fecal coliform bacteria shall not exceed a geometric mean of 200 fecal coliform bacteria per 100 mL of water for two or more samples over a calendar month nor shall more than 10% of the total samples taken during any calendar month exceed 400 fecal coliform bacteria per 100 mL of water. To ensure compliance with the new revised standard, the bacteria TMDLs for the impaired stream segments of the PR and OWC watersheds were developed to meet both the interim fecal coliform standard and the *E. coli* criteria.

2. STATE AND FEDERAL REQUIREMENTS FOR TMDL IMPLEMENTATION PLANS

2.1. Background

Once a water body is listed as impaired and a subsequent TMDL study has been conducted, then the state, in conjunction with watershed stakeholders, must develop and implement a strategy that will limit the pollutant loadings to those levels allocated in the TMDL. Such a strategy, also known as an Implementation Plan (IP), must contain corrective actions that when implemented will reduce pollutant loadings to bring the water body into compliance with the relevant standard(s).

2.2. State Requirements

The State's Water Quality Monitoring, Information and Restoration Act (WQMIRA) directs the VADEQ to "develop and implement a plan to achieve fully supporting status for impaired waters." In order for an IP to be approved by the State Water Control Board, the IP must include the following required components, as outlined in WQMIRA:

- date of expected achievement of water quality objectives;
- measurable goals;
- necessary corrective actions; and
- associated costs, benefits, and environmental impact of addressing the impairment.

2.3. Federal Recommendations

Section 303(d) of the CWA and current USEPA regulations do not require the development of implementation strategies, though their guidance clearly describes this as the next step leading to the attainment of water quality objectives. In its 1999 "Guidance for Water Quality-Based Decisions: The TMDL Process," USEPA recommends the following minimum elements for an approvable IP:

- a description of the implementation actions and management measures;
- a time line for implementing these measures;
- legal or regulatory controls;
- the time required to attain water quality standards; and
- a monitoring plan and milestones for attaining water quality standards.

These recommendations closely track the State's WQMIRA requirements.

2.4. Requirements for Section 319 Fund Eligibility

Beyond the regulatory requirements listed above, the CWA was amended in 1987 to establish the Nonpoint Source (NPS) Management Program in Section 319 of that act. Through that program, States, Territories, and Native American Tribes can receive grant monies for a variety of activities, including the restoration of impaired stream segments. Although there are several sources of money to help with the TMDL implementation process, Section 319 funds are substantial and most relevant to TMDL implementation. Therefore, the requirements to obtain these funds are discussed in this chapter. The Virginia Department of Conservation and Recreation (VADCR) strongly suggests that these USEPA recommendations be addressed in the IP (in addition to the required components as described by WQMIRA).

The USEPA develops guidelines that describe the process and criteria to be used to award CWA Section 319 NPS grants to States. The guidance is subject to revision and the most recent version should be considered for IP development. The "Supplemental Guidelines for the Award of Section 319 Nonpoint Source Grants to States and Territories in FY 2003" identifies the following nine elements that must be included in the IP to meet the 319 requirements:

1. Identify the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in the watershed-based plan;
2. Estimate the load reductions expected from NPS management measures;
3. Describe the NPS management measures that will need to be implemented to achieve the identified load reductions;
4. Estimate the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement the watershed-based plan;
5. Provide an information/education component that will be used to enhance public understanding of the project and encourage the public's participation in selecting, designing, and implementing NPS management measures;
6. Provide a schedule for implementing the NPS management measures identified in the watershed-based plan;
7. Describe interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented;

8. Identify a set of criteria for determining if load reductions are being achieved and progress is being made towards attaining water quality standards, and if not, the criteria for determining if the watershed-based plan needs to be revised; and
9. Establish a monitoring component to evaluate the effectiveness of the implementation efforts.

2.5. Staged Implementation

In general, the Commonwealth of Virginia intends for NPS pollutant TMDL reductions to be implemented in a staged or phased fashion. Staged implementation is an iterative process whereby management measures are implemented incrementally, initially targeting those sources and/or practices that are expected to produce the greatest water quality improvement. Staged implementation includes on-going monitoring to continuously assess progress toward attaining water quality standards. For example, a promising best management practice in agricultural areas of a watershed with a bacteria impairment is livestock exclusion from streams. This has been shown to be very effective in lowering bacteria concentrations in streams, by reducing the opportunity for cattle to defecate directly in the stream and by providing additional buffering in the riparian zone. This practice has the additional benefit of reducing stream bank erosion.

There are many benefits of staged implementation, including:

1. tracking water quality improvements as they occur;
2. providing a measure of quality control, given the uncertainties that exist in any implementation plan;
3. providing a mechanism for developing public support;
4. helping to ensure the most cost-effective practices are implemented initially; and
5. allowing for the evaluation of the adequacy of the TMDL in achieving the water quality standard.

With successful development and implementation of IPs, Virginia will be well on the way to restoring impaired waters and enhancing the value of this important resource. Additionally, development of an approved IP will improve a locality's chances for obtaining monetary assistance during implementation.

3. REVIEW OF THE PIGG RIVER AND OLD WOMANS CREEK TMDL STUDIES

3.1. Background

A TMDL is calculated as follows:

$$TMDL = \sum WLA + \sum LA + MOS \quad (3.1)$$

where WLA is the waste load allocation (point sources), LA is the load allocation (NPSs), and MOS is the margin of safety. A TMDL study determines the TMDL for the pollutant and, after accounting for MOS, allocates that loading between point sources (WLA) and NPSs (LA).

This chapter reviews how the TMDLs were developed for the five original impaired segments of the Pigg River and Old Womans Creek watersheds. The TMDLs are described in the 2006 TMDL report: *Bacteria Total Maximum Daily Load Development for Pigg River, Snow Creek, Story Creek, and Old Womans Creek*, available at http://www.deq.virginia.gov/tmdl/apptmdls/roankrvr/piggec.pdf.

3.2. Description of Impairments in the Pigg River and Old Womans Creek Watersheds

As a result of monitoring performed by VADEQ, ten stream segments in the PR and OWC watersheds are currently listed on Virginia's 303(d) list of impaired waters. Two of these stream segments (Story Creek and Upper Pigg River) were placed on Virginia's 303(d) list of impaired waters in 1996 for violations of the fecal coliform (FC) bacteria water quality standard. Two stream segments (Lower Pigg River and Leesville Lake-Pigg River) were listed in 1998 and two segments (Snow Creek and Old Womans Creek) were listed in 2002 for violations of the FC bacteria water quality standard. TMDL plans for each of these stream segments were developed and then approved by USEPA in 2006. Three additional segments, Big Chestnut Creek, Harpen Creek, and Tomahawk Creek, were listed as impaired after the TMDL study completed. Thus, TMDLs have not been developed for these three segments; however, since they are within the Pigg River watershed, this IP includes practices that address those impairments. The impairments are summarized in Table 3.1 and Figure 3.1.

Table 3.1. Impaired segments in the Pigg River and Old Womans Creek watersheds.

Stream	Original Listing Date	Instantaneous Bacteria Criterion at Time of Listing
Targeted in 2006 TMDL		
Story Creek (VAW-L14R-02)	1996	1,000 cfu/100 mL (Fecal Coliform)
Upper Pigg River (VAW-L14R-01)	1996	
Leesville Lake-Pigg River (VAW-L13L-01)	1998	
Snow Creek (VAW-L17R-01)	2002	
Old Womans Creek (VAW-L13R-01)	2002	
Listed as impaired since the 2006 TMDL		
Big Chestnut Creek (VAW-L15R-01)	2004	235 cfu/100 mL (*E. coli*)
Harpen Creek (VAW-L18R-01)	2006	
Tomahawk Creek (VAW-L18R-01)	2006	

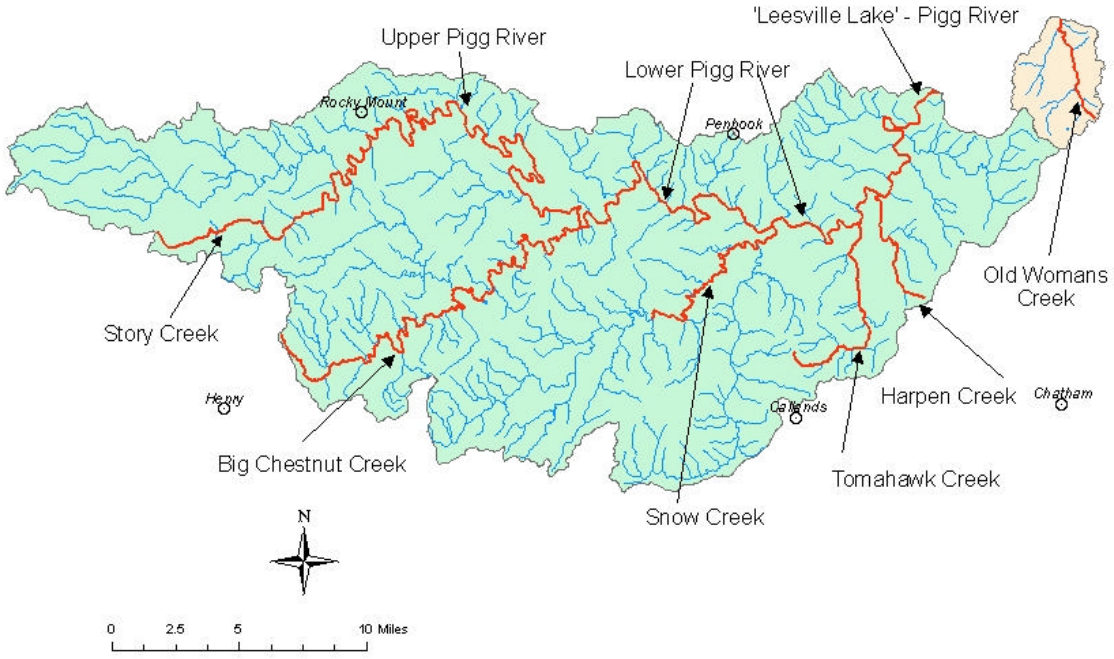

Figure 3.1. Impaired segments in the Pigg River and Old Womans Creek watersheds.

3.3. Watershed Characteristics

The PR and OWC watersheds (392 and 13 mi^2, respectively) lie in portions of Virginia's Franklin, Henry, and Pittsylvania counties. PR and OWC discharge into Leesville Lake. Leesville Lake is on the Roanoke River (USGS Hydrologic Unit Code 03010101), which flows south into North Carolina and eventually discharges to the Albemarle Sound. Snow Creek, Story Creek, Big Chestnut Creek, Harpen Creek, and Tomahawk Creek are all tributaries to the Pigg River.

General land use/land cover data for the PR and OWC watersheds were extracted from the 1992 National Land Cover Dataset (NLCD) and are shown in Figure 3.2. Land uses in the watersheds include residential, agricultural, and forest categories. Approximately 72% of the

watersheds is forested and 26% is agricultural. Residential and commercial land uses account for less than 2% of the watersheds.

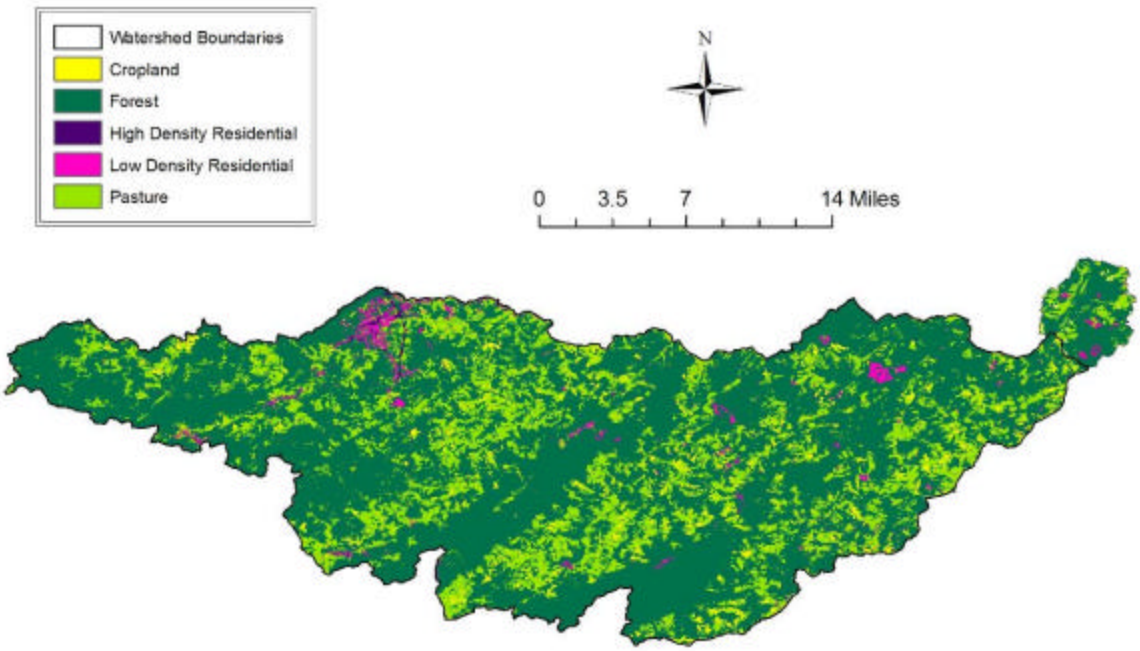

Figure 3.2. Land use distribution in the Pigg River and Old Womans Creek watersheds.

3.4. Water Quality Monitoring

Historically there have been many water quality monitoring stations in the PR and OWC watersheds. The monitoring stations specifically related to TMDL development are listed in Table 3.2. Data at all stations listed in Table 3.2 were collected on a monthly basis, although occasional exceptions to this schedule were found for each station.

3.5. Water Quality Modeling

The Hydrological Simulation Program-FORTRAN (HSPF) was used to simulate the fate and transport of fecal coliform bacteria in the PR and OWC watersheds. Modeling was conducted in phases. Output from the HSPF model was generated as an hourly time series and daily average time series of fecal coliform concentration at ten sub-watershed outlets, eight corresponding to the monitoring station locations in the PR watershed; and two corresponding to the monitoring station locations in OWC.

Table 3.2. Description of Monitoring Stations used in TMDL Development

Watershed	Station	Station Location	Period of Record†
Story Creek	4ASDA000.67	Davis Mill Bridge	7/2004 – 4/2005
Story Creek	4ASDA009.79	Rt. 623 bridge above Ferrum STP outfall	7/1988 – 4/2005
Snow Creek	4ASNW000.60	Kirby Ford Bridge (Pittsylvania Co.)	12/1988 – 4/2005
Big Chestnut Creek	4ACNT001.32	Rt. 715 bridge	1/1997 – 5/2001
Pigg River	4APGG003.29	Rt. 605 bridge	3/1990 – 4/2005
Pigg River	4APGG030.62	Rt. 646 bridge	7/1994 – 4/2005
Pigg River	4APGG052.73	Rt. 713 bridge upstream of Rocky Mount STP	3/1994 – 4/2005
Pigg River	4APGG068.49	Rt. 756 bridge	7/2001 – 4/2005
Old Womans Creek	4AOWC002.35	Paisley Rd. (Rt. 756)	7/2004 – 4/2005
Old Womans Creek	4AOWC005.36	Rt. 760 Bridge (Pittsylvania Co.)	8/1992 – 4/2005

†at time of TMDL development

The Expert System for Calibration of HSPF (HSPEXP) decision support software was used to develop a calibrated hydrologic HSPF input dataset for the PR watershed. Data for calibration were obtained from a USGS flow-monitoring station (USGS 02058400), located on the PR near Sandy Level, Virginia. No flow gage existed on OWC, and therefore, the calibrated hydrologic parameters from PR were used in the model for OWC. The water quality component of HSPF was calibrated at each monitoring station using observed fecal coliform data collected between July 1988 and April 2005 (Table 3.2).

While developing allocation scenarios, an implicit margin of safety (MOS) was used. Conservative assumptions, the use of a detailed watershed model (HSPF), and other considerations were used in developing the bacteria TMDL, such that an explicit MOS was not necessary.

3.6. Sources of Bacteria

To identify localized sources of fecal coliform, watersheds were divided into sub-watersheds (Figure 3.3) as follows: Story Creek, 2; Big Chestnut Creek, 3; Doe Run, 1; Snow Creek, 4; Tomahawk Creek, 2; Harpen Creek, 2; PR, 9; and OWC, 7. Potential sources of bacteria considered in the development of the TMDL included both point source and NPS contributions.

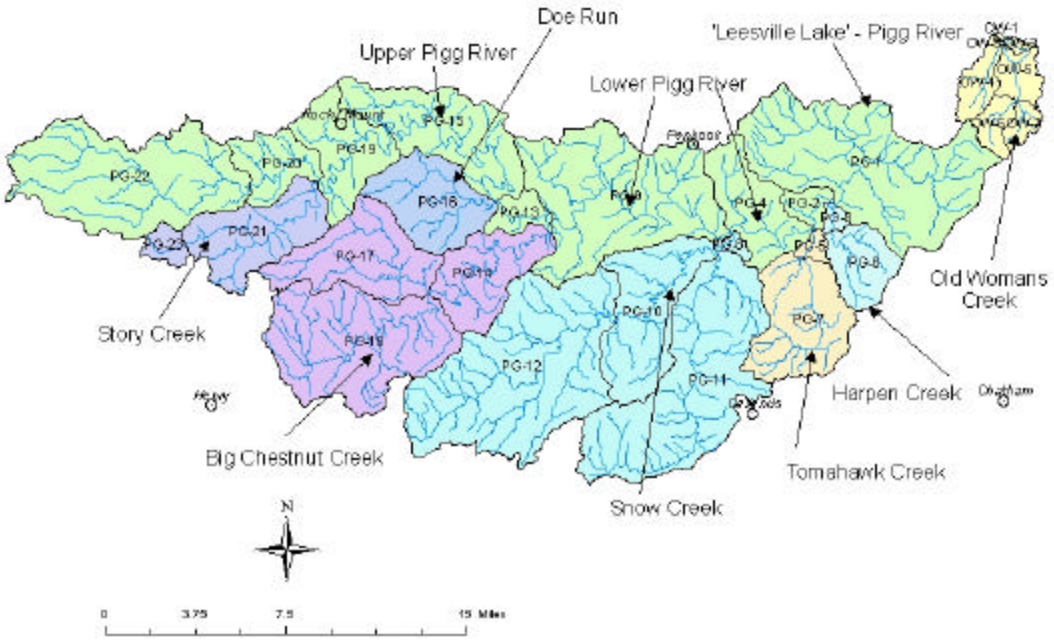

Figure 3.3. Sub-watersheds in the Pigg River and Old Womans Creek watersheds.

3.6.1. Point Sources

The TMDL WLA accounts for the portion of a receiving water's loading capacity that is allocated to one of its existing or future permitted point sources of pollution. Point sources of fecal coliform bacteria in the PR and OWC watersheds include all municipal and industrial plants that treat human waste and are issued individual permits by VADEQ, as well as private residences that fall under Virginia Pollutant Discharge Elimination System (VPDES) general permits. The point sources of bacteria in the PR watershed are listed in Table 3.3, along with their permitted discharges and load allocations in the TMDLs. The WLA for each point source was set at the permitted load. No permitted sources existed in the OWC watershed.

Table 3.3. Permitted facilities discharging into the streams of the Pigg River watershed.

Permit Number	Facility Name	Watershed	Design Flow (mgd*)	Permitted *E. coli* Conc. (cfu/100 mL)	*E. coli* Load Allocation (cfu/year)
VA0029254	Ferrum Town – STP	Story Creek	0.4	126	6.99×10^{12}
VA0091103†	Franklin County Commerce Center WWTP	Pigg River	0.02	126	3.48×10^{10}
VA0085952	Rocky Mount Town STP	Pigg River	2	126	3.48×10^{12}

*million gallons per day
†was not online during TMDL study

3.6.2. Nonpoint Sources

NPS pollution originates from diffuse sources on the landscape (e.g., agriculture and urban) and is strongly affected by precipitation events – runoff from rain or snowmelt. In some cases, a precipitation event is not required to deliver NPS pollution to a stream (e.g., direct deposition of fecal matter by wildlife or livestock and contamination from leaking sewer lines or straight pipes). NPSs were assessed during TMDL development through an extensive analysis of land use coupled with a consideration for delivery mechanisms (e.g., direct loadings to the stream or land-based loadings that require a precipitation event for delivery of the pollutants to the stream from pervious and impervious surfaces).

In general, wildlife contribute bacteria to all land uses and to streams via defecating directly in streams (direct deposit); livestock contribute bacteria to pasture areas and streams via direct deposit and indirectly to crop areas through manure application; humans contribute bacteria to residential areas via failing septic systems and to streams via straight pipes; and pets contribute bacteria directly to residential areas. The estimated NPS loads from each of the sources of bacteria are summarized in Table 3.4.

Table 3.4. Estimated annual fecal coliform loadings to the stream and the various land use categories for the Pigg River and Old Womans Creek watersheds at the time of TMDL development (2006).

Source	Estimated fecal coliform loading ($x10^{12}$ cfu/yr)		Percent of total loading	
	Pigg River	Old Womans Creek	Pigg River	Old Womans Creek
Direct loading to streams				
Cattle in stream	547	5.7	<1%	<1%
Wildlife in stream	377	7.7	<1%	<1%
Straight pipes	25	0	<1%	0%
Loading to land surfaces				
Cropland	542	6.8	<1%	<1%
Pasture	54,189	1,080	82%	80%
Residential	5,196	92	8%	7%
Forest	5,459	156	8%	12%
Total	66,335	1,348		

3.7. TMDL Allocations and Load Reductions

Various pollutant reduction scenarios were evaluated to meet the state water quality standards for *E. coli*, the 30-day geometric mean target (126 cfu/100 mL) and the single sample maximum (235 cfu/100 mL), with zero violations (a requirement of the TMDL). An implicit MOS was used in these bacteria TMDLs by using conservative estimations of all factors that would affect bacteria loadings in the watershed (e.g., animal numbers, production rates, contributions to the stream). These factors were estimated in such a way as to represent the highest amount of bacteria from each source in the watershed. In addition to anthropogenic source reductions, the PR and OWC TMDLs call for reductions from wildlife sources. The final allocation scenarios from each watershed are shown in Table 3.5. The TMDL equations, which include *E. coli* allocations for point (WLA) and non point (LA) sources, are given in Table 3.6.

In addition to the final pollutant source reduction scenarios, a transitional (Stage 1) pollutant source reduction scenario was developed during the TMDL study, Table 3.7. The Stage 1 allows a 10.5% violation rate of the applicable single-sample *E. coli* criterion, 235 cfu/100 mL, and often reflects smaller pollutant source reductions in anthropogenic sources. Implementation of the Stage 1 scenario permits an evaluation of the modeling assumptions and the effectiveness of management practices.

Table 3.5. Final pollutant source reduction scenarios for the Pigg River and Old Womans Creek watersheds.

Impaired Watershed	Required Fecal Coliform Loading Reductions to Meet the *E coli* Standards,%					
	Cattle DD*	Loads from Cropland	Loads from Pasture	Wildlife DD*	Straight Pipes	Loads from Residential
Snow Creek	60	0	95	0	100	95
Story Creek	100	0	85	45	100	75
Upper Pigg River†	100	0	95	5	100	90
Leesville Lake – Pigg River‡	100	0	95	30	100	90
Old Womans Creek	100	0	90	67	n/a	85

*DD = direct deposit
†Includes reductions for Story Creek applied to the Story Creek portion of the watershed
‡Includes reductions for Story Creek, Snow Creek, and Upper Pigg River applied to the appropriate portions of the watershed
n/a = not applicable; no straight pipes exist in the Old Womans Creek watershed

Table 3.6. TMDL equations for the Pigg River and Old Womans Creek watersheds.

Impaired Segment	SWLA	SLA	MOS*	TMDL
Snow Creek	<1%	8.47×10^{13}	–	8.60×10^{13}
Story Creek	6.99×10^{11}	1.86×10^{13}	–	1.93×10^{13}
Upper Pigg River†	<1%	4.86×10^{13}	–	4.91×10^{13}
Leesville Lake – Pigg River‡	3.51×10^{12}	1.91×10^{14}	–	1.94×10^{14}
Old Womans Creek	<1%	7.17×10^{12}	–	7.24×10^{12}

*Implicit MOS
†Loads excluding those from Story Creek
‡Loads excluding those from Story Creek, Snow Creek, and Upper Pigg River

Table 3.7. Allocation scenarios for Stage 1 implementation for the impaired segments.

Impaired Segment	Single Sample Standard Percent Violation	Required Fecal Coliform Loading Reductions to Meet the Stage 1 Goal, %					
		Live-stock DD	Loads from Cropland	Loads from Pasture	Wildlife DD	Straight Pipes	Loads from Residential
Snow Creek	9	5	0	0	0	100	0
Story Creek	8	90	0	0	0	100	0
Upper Pigg River*	9	65	0	0	0	100	0
Leesville Lake - Pigg River†	10	10	0	0	0	100	0
Old Womans Creek	9	100	0	90	0	n/a	85

*Includes reductions for Story Creek applied to the Story Creek portion of the watershed
†Includes reductions for Story Creek, Snow Creek, and Upper Pigg River applied to the appropriate portions of the watershed
n/a = not applicable; no straight pipes exist in the Old Womans Creek watershed

4. PUBLIC PARTICIPATION

4.1. Introduction

An essential step in crafting a TMDL implementation plan and then implementing that plan is input from and engagement of a broad range of stakeholders (individuals, agencies, organizations, and businesses who have an interest in improving water quality and a familiarity with local conditions). Public participation involves a dialogue between local stakeholders and government agencies and a discussion of available resources that can be devoted to TMDL implementation, such as funding and technical support.

The stakeholders involved in developing the PR and OWC TMDL IP included a Resource Team, a Steering Committee, Working Groups, and the general public. The Resource Team included staff with the VADEQ, VADCR, and faculty with the Center for Watershed Studies in the Biological Systems Engineering Department at Virginia Tech. Three Working Groups, two focused on agricultural issues and another on residential and governmental issues, and the Steering Committee were comprised of local watershed stakeholders. The PR and OWC Working Groups prepared and forwarded subcommittee reports to the Steering Committee. These reports are included in Appendix A. Public participation occurred via a series of Steering Committee and Working Group meetings, Table 4.1. These meetings, as well as additional public participation activities, are described in the following sections.

Table 4.1. Pigg River and Old Woman Creek TMDL Implementation Planning Meetings

Meeting Date	Meeting Type
May 1, 2008	Informational Kick-off Meeting
June 5, 2008	First Public Meeting
Aug. 14, 2008	Government and Residential Working Group
Oct. 30, 2008	Agricultural Working Group: Franklin County
Nov. 6, 2008	Agricultural Working Group: Pittsylvania County
Dec. 17, 2008	Steering Committee Meeting
Feb. xx, 2009	Steering Committee Meeting
Feb. 19, 2009	Final Public Meeting

4.2. Synopsis of Pigg River and Old Womans Creek TMDL Implementation Planning Meetings

The first of two public-noticed public meetings occurred on May 1, 2008 in Rocky Mount, VA. Eleven stakeholders attended the first public meeting. The goals of the public meeting were:

- to provide a basic introduction to the process of implementing TMDLs;

- to engage the community through the Steering Committee and the Working Groups; and
- to explain the roles and responsibilities of each Working Group and the commitment needed for a successful process.

Working Groups were developed that included stakeholders with common interests and concerns about the implementation process. The Government/Residential Working Group focused on both residential and public works issues, while the Agricultural Working Groups focused on both agriculture and rural/residential issues. Each Working Group was charged with discussing, analyzing, and prioritizing potential bacteria pollutant source reduction corrective measures.

Working Group meetings occurred on August 4, October 30, and November 6, 2008, Table 4.1. The Working Groups provided an opportunity for participants to give direct feedback to the Resource Team about potential sources of problems and appropriate solutions to impairments. The goals of these meetings were:

- to review the purpose and process of the IP;
- to update existing maps with respect to land use and bacteria sources;
- to identify locations of known or suspected water quality problems due to bacteria; and
- to identify corrective measures (best management practices (BMPs) and other approaches) for reducing bacteria loads.

Working Group input was then passed to the Steering Committee whose job it was to balance the interests and desires voiced in the Working Groups. The process of refining Working Group input and working with the Resource Team was iterative. Two Steering Committee meetings were held on December 17, 2008 and February xx, 2009. The goals of the Steering Committee meetings were:

- to present the Steering Committee with a summary of the previous public and Working Group meetings (December 17);
- to update the Steering Committee on the status of the IP and a summary of the previous meeting (both meetings);
- to collect and refine input from the Steering Committee on the suite of corrective measures (BMPs) recommended by the Working Groups (February xx, 2009); and
- to present and solicit feedback on the draft TMDL IP (February xx, 2009).

The second and final public meeting occurred on February 19 in Rocky Mount, VA. xx stakeholders attended the meeting. The goals of the meeting were:

- to review the TMDL implementation planning process and the chronology of the TMDL IP;
- to review the analysis and techniques used to determine the final suite of corrective measures included in the TMDL IP; and
- to solicit stakeholder feedback (a formal 30-day public comment period following the final public meeting).

4.3. Outreach Efforts to Solicit Public Participation

An electronic mailing list of stakeholders was initiated at the beginning of the project and expanded throughout the duration of the project. By the end of IP development, this list included xx stakeholders. Meeting announcements and reminders were sent via this list. Newspaper articles were written in the *Franklin News-Post* and the *Chatham Star-Tribune* to encourage local participation and announce future meetings. Meeting fliers advertising the public meetings were posted in public places throughout both Counties and real-estate style meeting announcement signs were posted at bridge crossings of some of the impaired streams. The Agricultural Working group meetings were advertised in the newsletters for the respective Soil and Water Conservation Districts. Interested stakeholders who do not use email were. Additional announcements of interest to stakeholders were sent via this list. The Center for Watershed Studies at Virginia Tech also maintained a threaded-discussion forum for the project.

5. IMPLEMENTATION ACTIONS

An important element of the TMDL implementation plan is to encourage voluntary implementation of control measures (BMPs and other approaches) designed to reduce pollutant loads. To encourage voluntary implementation, information must be obtained/developed on the types of control measures that can achieve the pollutant reduction goals specified in the TMDL as practically and cost-effectively as possible.

5.1. Selection of Appropriate Control Measures

Potential control measures, their costs, and pollutant removal effectiveness estimates were identified through a review of the PR and OWC TMDL, through input from the TMDL IP Working Groups and Steering Committee, from a literature review, and from modeling. Because the PR and OWC watersheds contain a combination of agricultural and residential land uses, implementation actions to address the required pollutant reductions include of a variety of control measures to address each pollutant source. Control measure selection was based on the ability to control specific pollutant sources, the required pollutant load reductions, the potential for cost-sharing, the likelihood of implementation by landowners, and the input of the watersheds' stakeholders. Pollutant sources fall into two basic categories: those contributing directly to the stream and those contributing indirectly to the stream from land sources.

5.1.1. Control Measures for Direct Stream Sources

Control measures were needed to reduce pollutant sources that contribute directly to the stream, the "Direct Stream Sources". The Direct Stream Sources that need to be controlled in PR and OWC include livestock direct deposit and direct residential wastewater discharges (straight pipes). In order to meet the 60-100% reduction in direct deposits from livestock, some form of stream exclusion is necessary. The 100% reduction in bacteria loads from the direct residential wastewater discharges is a pre-existing legal requirement, further reinforced by this TMDL and TMDL IP. Control measures used to address these sources include new septic systems, alternative on-site sewage treatment systems, or connection to an available sewer system.

5.1.2. Control Measures for Indirect Land Sources

Control measures were also needed to reduce pollutant sources that are distributed across the land surface, whose loads are then transported to streams via surface runoff, the "Indirect Land Sources". Control measures may reduce bacteria loads to the land surface, or may reduce

bacteria transport by surface runoff through infiltration, filtration, or deposition (reductions in flow velocity). The Indirect Land Sources that need to be controlled include runoff from pasture (livestock) and residential areas (failing septic systems and pet waste).

The final set of control measures and their related efficiencies used in this study to estimate pollutant load reductions are listed in Table 5.1. The control measures are arranged by general land use/source categories. Appendix B provides a glossary of BMP and other control measure definitions. Appendix C contains a list of BMP codes and practice names.

5.2. Quantification of Control Measures by Pollutant Source

The extent of existing control measures previously implemented in the PR and OWC watersheds were quantified using the VADCR and USDA Conservation Reserve Enhancement Program (CREP) databases and from estimates provided by local Soil and Water Conservation Districts (SWCD). The initial list of control measures considered for the PR and OWC TMDL IP included those practices already installed in the watersheds, given that there is already some degree of acceptability for these types of control measures. An analysis was then performed to identify the maximum extent of each measure needed to meet needed pollutant reduction goals. The initial list of control measures was supplemented with additional measures through discussions with stakeholders. Additional measures needed to meet the bacteria reduction targets (Table 5.1) were identified through discussions with working group participants and quantified using a combination of GIS analysis and modeling, followed by spreadsheet analyses to calculate load reductions from each control measure as applied to each pollutant type and source category. This section provides a summary of the final set of control measures and extents needed to achieve the pollutant load reductions specified in the TMDL.

Load reductions were based on source loads simulated for the TMDL study, changes in land use, and the application of effectiveness estimates. Appendix D provides additional details on load reduction calculations.

Table 5.1. Potential Control Measure Efficiencies for Bacteria.

Control Measures	Associated Cost-shared BMPs	% Effectiveness	% Effectiveness Source
Agricultural Control Measures			
Grass riparian buffers~	CP-21, WQ-1	48%	1
Forested riparian buffers~	CREP-22, CRFR-3	48%	1
Reforestation of erodible pasture	FR-1	simulated	2
Manure storage facility - beef	WP-4	75%	6
- dairy		75%	6
- poultry		99%	5
Livestock exclusion fencing	SL-6, SL-6B, WP-2T	100%	3
Livestock exclusion buffers	SL-6, SL-6B, WP-2T	40%	1
Adaptive fencing		100%	3
Hardened crossings*	SL-11B, WP-2B		
Alternative water systems*	SL-6B		
Improved pasture management		92%	4
Loose cattle housing facility	WP-4B, WP-8	75%	7
Residential Control Measures			
Pet waste program		75%	5
Bioretention filters~		85%	3
System Pumpouts	RB-1		
New Sewer Hookups	RB-2	100%	3
System Repairs	RB-3	100%	3
New Septic Systems	RB-4	100%	3
New Septic Systems w/ pumps	RB-4P	100%	3
Alternative Septic Systems	RB-5	100%	3

~ Includes additional reductions from upstream runoff loads: buffers - 4x buffer area; bioretention filters - 20x.
* Included as part of exclusion fencing systems.
1 - EPA-CBP sediment effectiveness, 2008. (Bacteria efficiency assumed equal to sediment efficiency.)
2 - Based on differential loading rates to different land uses.
3 - By definition.
4 - Virginia Tech, 2009.
5 - MapTech, Inc. 2006.
6 - EPA-CBP, 2003.
7 - Scraped manure transferred to manure storage, so bacteria reduction estimated same as WP-4.

5.2.1. Livestock Direct Deposit

Eliminating unrestricted livestock access to streams (100% livestock exclusion) is assumed to provide 100% reduction in livestock direct deposits. A GIS analysis was performed to delineate stream lengths adjacent to, or included in, pasture areas in the PR and OWC watersheds. The NLCD land use data layers were used for this analysis. Since NLCD data were also used for the determination of land use areas for TMDL modeling, these data were used for IP development to assess the relative position of pasture areas and streams. The National Hydrography Dataset

(NHD) streams layer was used to represent streams and to classify them as either perennial or intermittent.

"Livestock exclusion fencing" is defined as fencing that meets VADCR cost-share requirements with a minimum 35 ft. buffer, while "adaptive fencing" is defined as poly-wire fencing with a narrower buffer width. The option of "adaptive fencing" was discussed during the agricultural working group meetings. However, given that cost share monies are currently only available for fencing with a minimum 35 ft. buffer, and that the buffer area provides needed reductions of bacteria loads from pasture, it was decided not to include "adaptive fencing" as a control measure at this time. Table 5.2 summarizes the total fencing needs estimated to achieve the 60% reduction in bacteria loads from livestock direct deposits in Snow Creek and 100% reduction in bacteria loads from livestock direct deposits in all other watersheds, specified in the TMDL. Based on the distribution of stream locations, 80% of the required control measures are needed in Franklin County and Henry County, which are served by the Blue Ridge SWCD; and 20% in Pittsylvania County, which is served by the Pittsylvania SWCD.

Table 5.2. Stream Lengths and Total Stream Fencing Estimates.

Sub-basin	Stream Length (miles)	Stream Adjoining Pasture‡ (miles)	Estimated Livestock Exclusion Fencing Needed† (miles)	Existing or Approved BMP Stream-side Fencing× (miles)
Snow Creek	169	56	43	7.4
Story Creek	27	10	13	0.2
Upper Pigg River*	80	30	40	0.5
Leesville Lake – Pigg River**	368	100	132	5.9
Old Womans Creek	17	6	7	0.3
Total	**661**	**202**	**235**	**14.3**

* Includes watershed area upstream of Rocky Mount STP except for Story Creek portion of watershed.
**Includes watershed area from Rocky Mount STP to outlet except for Story Creek, Snow Creek, and Upper Pigg River portions of the watershed.
‡ May have pasture on one or both sides.
† Assumed no existing fencing.
× Estimated length of exclusion fencing – sources: VADCR BMP database (BMP completion date > 6/1/1999), Pittsylvania SWCD, and Blue Ridge SWCD (reported May 2008).

The typical cost-shared BMPs for livestock exclusion are the SL-6 and WP-2T systems of practices. The SL-6 practice (Grazing Land Protection Systems) includes streamside fencing, cross fencing, alternative water system(s), hardened crossing(s) when needed, and a 35-ft buffer from the stream. Based on data from the VADCR Agricultural BMP database and the Pittsylvania and Blue Ridge SWCDs, there were 53 SL-6 systems installed or under contract in

the PR and OWC watersheds since 1994, which, on average, included 2,913 feet of stream exclusion fencing and an average cost of $18,688. However discussions with local SWCD personnel reported that the average cost of a system has been increasing. Based on these discussions, an SL-6 system was defined as 3,000 feet of stream exclusion fencing at an average system cost of $20,000.

Some operations requiring fencing already have alternative water systems in place, and for these operations, the WP-2T practice (Stream Protection Systems) will be more appropriate. The WP-2T practice includes stream-side fencing with a 35-ft buffer and hardened stream crossing(s), if needed. From discussions with local SWCD personnel, fencing installation was estimated as $3.50 per linear foot and a hardened stream crossing estimated at $6,000. The WP-2T system was defined as 2,000 feet of stream exclusion fencing, and one hardened stream crossing at an average system cost of $13,000. The shorter length is justified for the WP-2T systems because these systems were more likely to be used along perennial streams, whereas SL-6 installations were considered to include a combination of perennial and intermittent streams.

It is expected that the targeted implementation of the SL-6 systems will address the majority of the fencing needs for livestock exclusion in the watershed. The installation of these systems should be given a high priority as they are likely to achieve greatest water quality improvement. The remaining fencing needs will be met through the implementation of WP-2T practices. Approximately 7% of the extent of required stream fencing was estimated as being installed through the WP-2T practice and the remaining amount through the SL-6 practice. In the PR and OWC watersheds, this amounts to 395 SL-6 systems and 55 WP-2T systems. This IP focuses on fencing along both perennial and intermittent streams because the TMDL requires stringent reductions of fecal bacteria from direct livestock and agricultural nonpoint sources.

5.2.2. Straight Pipes and Failing Septic Systems

The percentages of the population with failing septic systems and straight pipes in the PR and OWC watersheds were estimated as 27.1% and 0.2%, respectively, of the non-sewered population in each sub-watershed, according to the TMDL report. The TMDLs call for the removal of all straight pipes in the impaired watersheds in order to meet the TMDL load reductions. Addressing failing septic systems will reduce the bacteria load from residential runoff. It was assumed that 10% of straight pipes would need to be replaced with alternative waste treatment systems and the remainder with conventional septic systems. Based on

discussions during the residential working group meeting, it was assumed that 80% of failing septic systems could be repaired without installing a new system. Of those failing systems needing to be replaced, the Residential Working Group estimated that 30% would need to be replaced with alternative waste treatment systems because of soil and bedrock limitations in the watershed. Of the failing septic systems to be replaced with a conventional septic system, the Steering Committee estimated that 70% of these would need to include a pump. Table 5.3 gives a summary of control measures estimated to remediate this source of bacteria. In addition to these control measures, an educational effort will be important for successful implementation. Based on the distribution of population, 81% of the needed control measures are in Franklin County, 3% are in Henry County, and 16% are in Pittsylvania County.

Table 5.3. Residential Wastewater Control Measures.

Sub-basin	Septic System Repair	Installation of Conventional Septic System	Installation of Alternative Waste Treatment System
Snow Creek	277	52	20
Story Creek	193	37	13
Upper Pigg River*	347	65	27
Leesville Lake – Pigg River**	813	144	63
Old Womans Creek	28	5	2
Total	**1,658**	**303**	**125**

* Includes watershed area upstream of Rocky Mount STP except for Story Creek portion of watershed.
**Includes watershed area from Rocky Mount STP to outlet except for Story Creek, Snow Creek, and Upper Pigg River portions of the watershed.

5.2.3. Pasture

Runoff from pasture is also a source of bacteria loads. Bacteria loads to pasture areas come from grazing livestock, the spreading of stored manure, and wildlife. The control measures needed to meet TMDL load reductions for bacteria are shown in Table 5.4**Error! Reference source not found.**. After accounting for load reductions from currently installed control measures, load reductions resulting from filtering effects of buffers associated with livestock exclusion fencing were quantified. Load reductions realized by reforestation of 10% of the pasture land in Pittsylvania County were also quantified. Bacteria load reductions to the pasture surface due to the application of stored manure were also credited. Stored manure contains fewer bacteria because bacteria die-off occurs while the manure is in storage. During the TMDL study, t was estimated that 14% of the manure stored in the PR watershed is applied to pasture, and none of the manure stored in the OWC watershed is applied to pasture. Upon the recommendation of local SWCD personnel, loose cattle housing facilities were added as a

control measure option. Improved pasture management was included on pasture acreage as a companion to livestock exclusion control measures. Finally,

Table 5.4. Agricultural best management practice quantities required to meet TMDL.

Sub-basin	No. of SL-6 systems	No. of WP-2T systems	Reforestation of Pasture (acres)	Pastures needing Improved Pasture Management (%)	Improved Pasture Management (acres)	Pastures needing Loose Cattle Housing Facilities (%)	Loose Cattle Housing Facilities (animal units)	Area Treated by Bioretention Filters (acres)
Snow Creek	72	9	-	100	15,779	100	2,787	80
Story Creek	23	4	-	90	606	0	-	-
Upper Pigg River*	66	9	-	100	4,140	80	1,530	-
Leesville Lake – Pigg River**	221	29	610	100	27,473	95	5,369	76
Old Womans Creek	13	4	39	90	288	0	-	
Total	**395**	**55**	**649**		**48,286**		**9,686**	**156**

* Includes watershed area upstream of Rocky Mount STP except for Story Creek portion of watershed.
**Includes watershed area from Rocky Mount STP to outlet except for Story Creek, Snow Creek, and Upper Pigg River portions of the watershed.

bioretention was needed to filter the bacteria load from runoff on 10% of pasture area for the Snow Creek watershed and 5% of pasture area for the lower Pigg River watershed to meet the required reductions to land-based pasture loads. This collective set of control measures provided the needed bacteria load reductions. Based on the distribution of pasture, 71% of the needed control measures are needed in Franklin County and Henry County and 29% in Pittsylvania County.

5.2.4. Residential

Pet waste is a significant source of bacteria loading on residential areas in the PR and OWC watersheds. The consensus at the residential working group meeting was that a pick-up-after-your-pet campaign would go unnoticed in the watersheds given the rural environment of the area. The group recommended that the clean-up plan should focus efforts on straight pipes and failing septic systems and not include a pet waste program. However, given the large reductions needed to land-based residential loads to meet the TMDL, modeling efforts showed that pet waste reduction is needed in addition to the reductions of human waste. A Residential Pet Waste Education Program is proposed to educate homeowners and kennel owners in the watersheds how to dispose of pet waste properly. The residential working group suggested that kennels, pet breeders, and veterinary offices in the watershed also be contacted about the proper elimination of pet waste.

Street sweeping is also an effective control measure for reducing bacteria loads in residential areas. The Town of Rocky Mount has been using a mechanical street sweeper for the past 12 years on a bi-weekly schedule.

5.3. Technical Assistance Needs

Technical assistance is needed for design and installation of control measures, as well as for educational outreach. An average of 2 full-time-equivalent (FTE) employees per year is needed to address agricultural issues. Residential technical assistance requires 1 FTE per year. These estimates were based on similar projects and experience and knowledge of the Steering Committee. Educational outreach will include strategies identified by stakeholders for facilitating installation and execution of implementation actions.

5.4. Cost/Benefit Analysis

5.4.1. Costs

The extent of the agricultural control measures quantified earlier in this chapter for meeting TMDL pollutant reductions are summarized in Table 5.5, together with their unit costs and implementation costs. Unit costs were estimated from the VADCR agricultural BMP database for Franklin and Pittsylvania counties, from the 2008 USDA-NRCS cost list for Virginia, from literature values, and from discussions with Steering Committee and Working Group members. The total estimated cost for full implementation of agricultural control measures in the PR and OWC watersheds is $28.8 M.

Table 5.5. Total cost estimates for agricultural control measures in the Pigg River and Old Womans Creek watersheds.

Practice	Unit	Quantity	Cost/ Unit	Cost Source	Total
SL-6 System	system	395	$20,000	1	$7,900,000
WP-2T System	system	55	$13,000	1	$715,000
Reforestation of Pasture	acre	649	$1,355	2	$879,395
Improved Pasture Management	acre	48,286	$107	3	$5,166,602
Loose Cattle Housing Facility	animal	9,686	$1,192	1	$11,545,712
Bioretention Filter	acre	156	$10,000	3	$1,560,000
Technical Assistance	person-years	20	$50,000		$1,000,000
Total					**$28,766,709**

1 - SWCD estimate includes BMP-defined components and component costs.
2 - USDA-NRCS, 2007.
3 - MapTech, Inc., 2006.

The residential implementation actions consist of repairing or replacing failing septic systems and straight pipe discharges within the PR and OWC watersheds and implementing a Residential Pet Waste Education Program. Considerations are also made for alternative waste treatment systems where soils or groundwater conditions are not suitable for conventional septic systems. Typical costs in the region show that a septic system repair costs an estimated $2,000, a conventional septic system is estimated at $6,000 with pump and $3,900 without a pump, and an alternative waste treatment system is estimated at $15,000 to replace a failing septic system and $20,000 to replace a straight pipe. Table 5.6 summarizes all costs associated with the residential improvements, including replacing all straight pipes in the PR and OWC watersheds with either a conventional septic system or an alternative waste treatment system and replacing or repairing all failing septic systems. The total estimated cost for full implementation of residential control measures in the PR and OWC watersheds is $7.3 M.

Table 5.6. Total cost estimates for residential control measures in the Pigg River and Old Womans Creek watersheds.

Practice	Estimated no. of systems needed	Cost/system	Total Cost
Replacing Straight Pipes			
Conventional Septic System (with pump)	12	$6,000	$72,000
Alternative Waste Treatment System	2	$20,000	$40,000
Repairing Failing Septic Systems	1,658	$2,000	$3,316,000
Replacing Failing Septic Systems			
Conventional Septic System	291		
without pump	*87*	$3,900	$339,300
with pump	*204*	$6,000	$1,224,000
Alternative Waste Treatment System	123	$15,000	$1,845,000
Residential Pet Waste Education Program	1	$3,750*	$3,750
Technical Assistance (person-years)	10	$50,000	$500,000
Total			**$7,340,050**

* MapTech, Inc., 2006.

5.4.2. Benefits

It is hard to gage the impact that reducing fecal contamination will have on public health, as most cases of waterborne infection are not reported or are falsely attributed to other sources. However, because of the reductions required, the incidence of infection from fecal sources through contact with surface waters should be reduced considerably.

The primary benefit of implementation is improving water quality in Virginia by reducing the fecal contamination in the PR and OWC watersheds. Many of the control measures intended to reduce bacteria also increase infiltration, which will decrease peak flows downstream.

During implementation planning, it is important to recognize that healthy waters improve economic opportunities for Virginians and a healthy economic base provides the resources and funding necessary to pursue restoration and enhancement activities. The agricultural, residential, and urban practices recommended in this document will provide economic benefits to the community, as well as the expected environmental benefits.

Specifically, alternative (clean) water sources, exclusion of cattle from streams, improved pasture management, and private sewage system maintenance will each provide economic benefits to land owners. Money spent by landowners and state agencies in the process of implementing this plan will stimulate the local economy.

A clean water source has been shown to improve weight gain and milk production in cattle. Fresh clean water is an essential requirement for healthy livestock, with healthy cattle consuming, on a daily basis, close to 10% of their body weight during winter and 15% of their body weight in summer. Many livestock illnesses can be spread through contaminated water supplies. For instance, coccidia can be delivered through feed, water and haircoat contamination with manure (VCE, 2000). In addition, horses drinking from marshy areas or areas where wildlife or cattle carrying Leptospirosis have access tend to have an increased incidence of moonblindness associated with Leptospirosis infections (VCE, 1998a). Some farmers have also noticed decreased leg injuries in livestock from crossing steep or muddy stream banks (Zeckoski *et al.*, 2007). A clean water source can prevent illnesses that reduce production and incur the added expense of avoidable veterinary bills.

In addition to reducing the likelihood of animals contracting waterborne illnesses by providing a clean water supply, streamside fencing excludes livestock from wet, swampy environments as are often found next to streams where cattle have regular access. Keeping cattle in clean, dry areas has been shown to reduce the occurrence of mastitis and foot rot. Virginia Cooperative Extension (VCE, 1998b) reports that mastitis costs producers $100 per cow in reduced quantity and quality of milk produced. On a larger scale, mastitis costs the U.S. dairy industry about $1.7-2 billion annually or 11% of total U.S. milk production (VCE, 1998c). While the spread of mastitis through a dairy herd can be reduced through proper sanitation of milking equipment, mastitis-causing bacteria can be harbored and spread in the environment where cattle have access to wet and dirty areas. Installation of streamside fencing and well managed loafing areas will reduce the amount of time that cattle have access to these areas.

Implementing an improved pasture management system in conjunction with installing clean water supplies will also provide economic benefits for the producer. Improved pasture management can allow a producer to feed less hay in winter months, increase stocking rates by 30 to 40%, and consequently, improve the profitability of the operation. With feed costs typically responsible for 70 to 80% of the cost of growing or maintaining an animal, and pastures providing feed at a cost of 0.01 to 0.02 cents/lb of total digestible nutrients (TDN) compared to 0.04 to 0.06 cents/lb TDN for hay, increasing the amount of time that cattle are fed on pasture is clearly a financial benefit to producers (VCE, 1996). Standing forage utilized directly by the grazing animal is always less costly and of higher quality than the same forage harvested with equipment and fed to the animal. Distributed off-stream waterers and cross-fencing can also improve forage utilization and manure nutrient distribution throughout a pasture (Zeckoski *et al.*,

2007). In addition to reducing costs to producers, intensive pasture management can boost profits, by allowing higher stocking rates and increasing the amount of gain per acre. Another benefit is that, at any given time cattle are in a smaller area, facilitating inspection and handling. The agricultural BMPs recommended in this document will provide both environmental benefits and economic benefits to the farmer.

The residential pollutant control measures discussed herein will play an important role in improving water quality, since human waste can carry with it human viruses in addition to the bacterial and protozoan pathogens that all fecal matter potentially carry. An improved understanding of on-site sewage treatment systems, including knowledge of what steps can be taken to keep them functioning properly, will give homeowners the tools needed for extending the life of their systems and reducing the overall cost of ownership. The average septic system will last 20 to 25 years, if properly maintained. Proper maintenance includes: knowing the location of the system components and protecting them (e.g., not driving or parking on top of them), not planting trees in locations where roots could damage the system, keeping hazardous chemicals out of the system, and pumping out the septic tank every 3 to 5 years. The cost of proper maintenance, as outlined here, is relatively inexpensive in comparison to repairing or replacing an entire system. Additionally, the repair/replacement and pump-out programs will benefit owners of private sewage (e.g., septic) systems, particularly low-income homeowners, by sharing the cost of required maintenance.

In addition to the benefits to individual landowners, the economy of the local community will be stimulated through expenditures made during implementation, and the infusion of dollars from funding sources outside the impaired areas. Building contractors and material suppliers who deal with septic system pump-outs, private sewage system repair and installation, fencing, and other BMP components can expect to see an increase in business during implementation. Additionally, income from maintenance of these systems should continue long after implementation is complete. A portion of the funding for implementation can be expected to come from state and federal sources. This portion of funding represents money that is new to the area and will stimulate the local economy. In general, implementation will provide not only environmental benefits to the community, but economic benefits as well, which, in turn, will allow for individual landowners to participate in implementation.

6. MEASURABLE GOALS AND MILESTONES

6.1. Implementation Goals

The goals of TMDL implementation are to restore the water quality in the impaired stream segments in PR and OWC watersheds so that they comply with water quality standards and to de-list these segments from the Commonwealth of Virginia's 303(d) List of Impaired Waters. Progress towards these goals can be assessed during the implementation process by tracking the number/type of control measures that are installed and programs or policies developed and executed (implementation actions) and continued water quality monitoring. Improvements in water quality will be measured through monitoring of bacteria concentrations throughout the watersheds.

6.2. Implementation and Water Quality Milestones

Implementation milestones establish the fraction of implementation actions to be taken within certain timeframes. Water quality milestones establish the corresponding improvements in water quality that can be expected as the implementation milestones are achieved. A timeline was developed to summarize the water quality and implementation milestones for PR and OWC watersheds (Figure 6.1).

Many implementation activities are already underway in the watersheds. The PR and OWC Resource Team strongly supports these activities and recommends that the PR and OWC TMDL IP Steering Committee continue those efforts that are complementary to this plan.

The implementation of control measures will be accomplished in stages. In general, the Commonwealth intends that the needed control measures be implemented in a progressive process that first addresses the pollutant sources with the largest impact on water quality. This staged approach is based on meeting water quality goals over a fifteen-year period.

The TMDL lists an interim set of Stage 1 goals for bacteria load reductions and will serve as part of the first implementation milestone at the 5-year mark. These goals are summarized in Table 3.7. In addition, the Stage 1 goals for implementation in Pigg River will focus on implementing the Residential Pet Waste Education Program, installing 50% of residential BMPs to address failing septic systems, and installing 50% of agricultural BMPs for improved pasture management. Implementation of Stage 1 control measures is expected to reduce the bacteria loadings from controllable sources so that violations of the single sample maximum *E. coli*

criterion (235 cfu/100mL) are less than 10.5%.

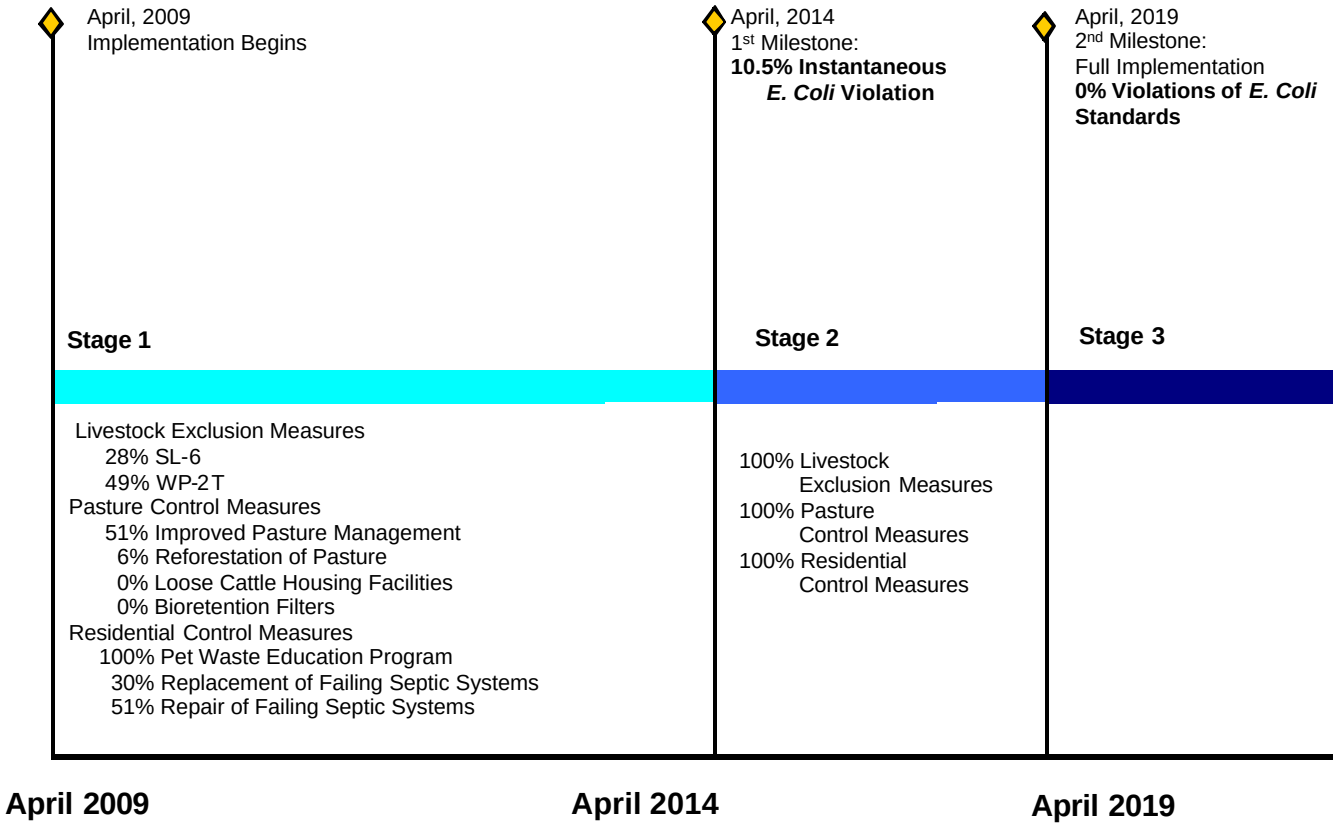

Figure 6.1. Implementation and water quality milestones for the Pigg River and Old Womans Creek watersheds.

Table 6.1 lists the control measures that are

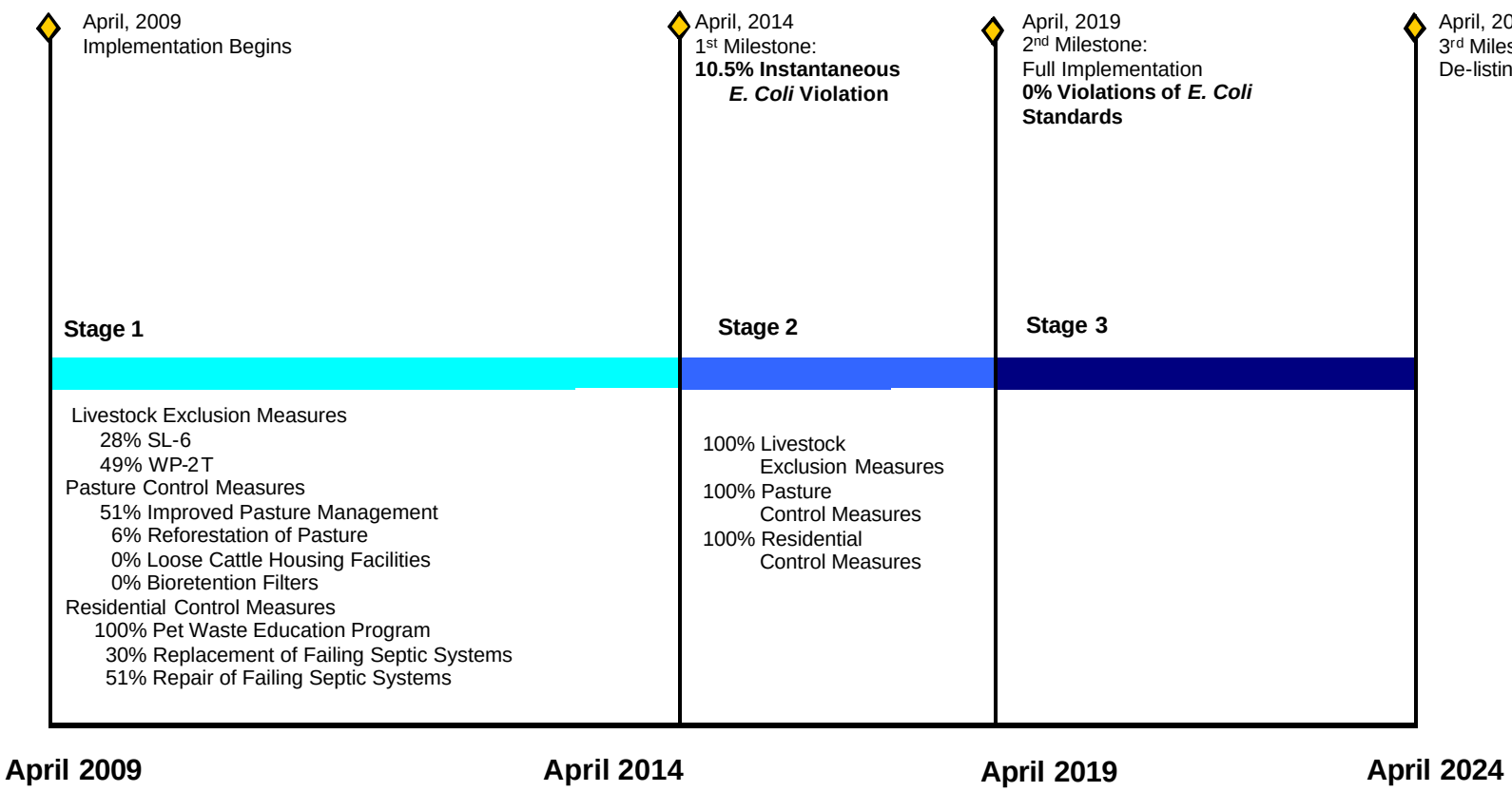

Figure 6.1. Implementation and water quality milestones for the Pigg River and Old Womans Creek watersheds.

Table 6.1. Best Management Practices to meet Stage 1 Implementation Goals for Pigg River and Old Womans Creek.

Sub-basin	Streams[‡] needing Fencing (%)	No. of SL-6 systems	No. of WP-2T systems	Reforestation of Pasture (acres)	Improved Pasture Management (acres)	Replace Straight Pipes	Repair Failing Septic Systems	Replace Failing Septic Systems	Residential Pet Waste Education Program[†]
Snow Creek	5	7	3	-	7,890	3	138	35	1
Story Creek	90	20	3	-	303	2	96	24	1
Upper Pigg River*	65	45	6	-	2,070	5	174	43	1
Leesville Lake – Pigg River**	10	27	10	-	13,736	4	406	102	1
Old Womans Creek	100	13	5	39	288	-	28	7	1
Total		**112**	**27**	**39**	**24,287**	**14**	**842**	**211**	**1**

* Includes watershed area upstream of Rocky Mount STP except for Story Creek portion of watershed.
**Includes watershed area from Rocky Mount STP to outlet except for Story Creek, Snow Creek, and Upper Pigg River portions of the watershed.
‡ Streams with pasture access
† One pet waste education program for all watersheds.

scheduled to be implemented in Stage 1. Local SWCD personnel have already started working with producers in the watersheds to install agricultural BMPs.

The remaining control measures will be installed during the next 5-year period (Stage 2). After installation of all control measures during the first two stages, full maturation of the control measures, full attainment of water quality goals (zero violations of the *E. coli* single sample maximum criterion) and de-listing from the Section 303(d) list will occur by the end of the last 5-year period (Stage 3). The BMPs needed to achieve Stage 2 (i.e., compliance with the TMDL), are summarized in Chapter 5, Tables 5.3 and 5.4. Table 6.2 lists the costs associated with Stage 1 and Stage 2 implementation efforts.

Table 6.2. Staged Implementation Costs for Pigg River and Old Womans Creek.

Type of Control Measure	Implementation Costs		
	Stage 1	**Stage 2**	**Total**
Livestock Exclusion Measures			
SL-6 systems	$2,240,000	$5,660,000	$7,900,000
WP-2T systems	$351,000	$364,000	$715,000
Pasture Control Measures			
reforestation of pasture	$52,845	$826,550	$879,395
improved pasture management	$2,598,709	$2,567,893	$5,166,602
loose cattle housing facilities		$11,545,712	$11,545,712
bioretention filters		$1,560,000	$1,560,000
Residential Wastewater Control Measures			
pet waste education program	$3,750		$3,750
conventional septic systems	$867,600	$767,700	$1,635,300
alternative waste treatment systems	$985,000	$900,000	$1,885,000
septic system repairs	$1,684,000	$1,632,000	$3,316,000
Technical Assistance			
agricultural BMPs	$500,000	$500,000	$1,000,000
residential BMPs	$250,000	$250,000	$500,000
Total	**$9,532,904**	**$26,573,855**	**$36,106,759**

Monitoring will continue throughout the process to document progress towards goals and to provide a mechanism for evaluating the effectiveness of the implementation actions for achieving intended water quality goals. The benefits of staged implementation are 1) as stream monitoring continues, it allows for water quality improvements to be recorded as they are being achieved; 2) it provides a measure of quality control, given the uncertainties which exist in any implementation plan; 3) it provides a mechanism for developing public support; 4) it helps to

ensure that the most cost-effective practices are implemented initially; and 5) it allows for the evaluation of the adequacy of the TMDL in achieving the water quality standard.

Once the implementation milestones and stages are established, the water quality improvement that should result from achieving each milestone can be predicted. The bacteria violations that result from each implementation milestone were estimated by using the modeling files that were developed during the TMDL process.

6.3. Reasonable Assurance

Public participation is an integral part of the IP development and is critical in gaining support for both the voluntary implementation activities that are being planned. During the public participation process, the major stakeholders in the watershed and a wide variety of local conservation agency personnel were involved in Working Groups and public meetings, and provided additional information through email and phone conversations. This participation by the major watershed stakeholders provides a reasonable assurance that the public was contributing to the TMDL process and had input into the selection of management and implementation practices recommended by this IP.

A PR and OWC TMDL IP Steering Committee will be formed following development of the implementation plan with guidance provided by agency members of the Resource Team, ensuring continuity of leadership and vision. Funding for implementation measures to improve water quality in the PR and OWC watersheds is currently being provided through DCR. TMDL Conservation Technicians are already on staff in the Blue Ridge and Pittsylvania SWCDs to assist agricultural producers in implementing BMPs.

Implementation to address the bacteria impairments on PR and OWC will be carried out primarily through the use of voluntary BMPs and education. While available cost-share programs will be utilized to the extent possible to provide incentives (typically at 75% of installation costs) to targeted watershed stakeholders, it is recognized that it may be necessary in some instances to raise the level of incentives to 100% to ensure participation by some stakeholders. Grant funding will be sought to provide this additional incentive, which is expected to increase participation from specific targeted stakeholders that would otherwise be reticent to participate.

Taken together, all of these planning components comprise a reasonable assurance that implementation will progress as planned and will lead to restoration of water quality in PR and OWC.

6.4. Implementation Tracking

VADCR will work with the Blue Ridge and Pittsylvania SWCDs to establish an agreement to oversee execution of the PR and OWC TMDL IP. Tracking of agricultural and residential practices will be done by the Districts through the existing BMPCSP tracking maintained by VADCR. Tracking information will include the locations and numbers of practices installed in the watershed. Strategies to facilitate implementation, such as educational programs and other outreach activities will also be tracked. The PR and OWC TMDL IP Steering Committee will continue to provide oversight and direction as needed during implementation.

6.5. Water Quality Monitoring

Virginia's 1997 Water Quality Monitoring, Information and Restoration Act requires that TMDL IPs include measurable goals and milestones for attaining water quality standards. Implicit in those milestones is the requirement of a method to measure progress. Water quality improvement will be evaluated through water quality monitoring conducted by VADEQ. VADEQ will monitor eight locations in the watersheds (Figure 6.2, Table 6.3). These ambient watershed stations will be sampled bi-monthly from April 2011 at the earliest and will continue through April 2019 (unless it is determined that additional sampling is needed). VADEQ will collect water quality data at each station, including, but not be limited to, the following parameters: *E. coli* bacteria, temperature, dissolved oxygen, and specific conductance.

Table 6.3. VADEQ Monitoring Stations in the Pigg River and Old Womans Creek Watersheds.

DEQ Station ID	Station Location	**Stream Name**
4ASDA000.67	Davis Mill Bridge	Story Creek
4ASNW000.60	Kirby Ford Bridge (Pittsylvania Co.)	Snow Creek
4ACNT001.32	Rt. 715 bridge	Big Chestnut Creek
4APGG030.62	Rt. 646 bridge	Pigg River
4AHPN001.62	Rt. 785 Bridge	Harpen Creek
4ATMA001.46	Rt. 644 Bridge	Tomahawk Creek
4APGG003.29	Rt. 605 bridge	Pigg River
4AOWC002.35	Paisley Rd. (Rt. 756)	Old Womans Creek

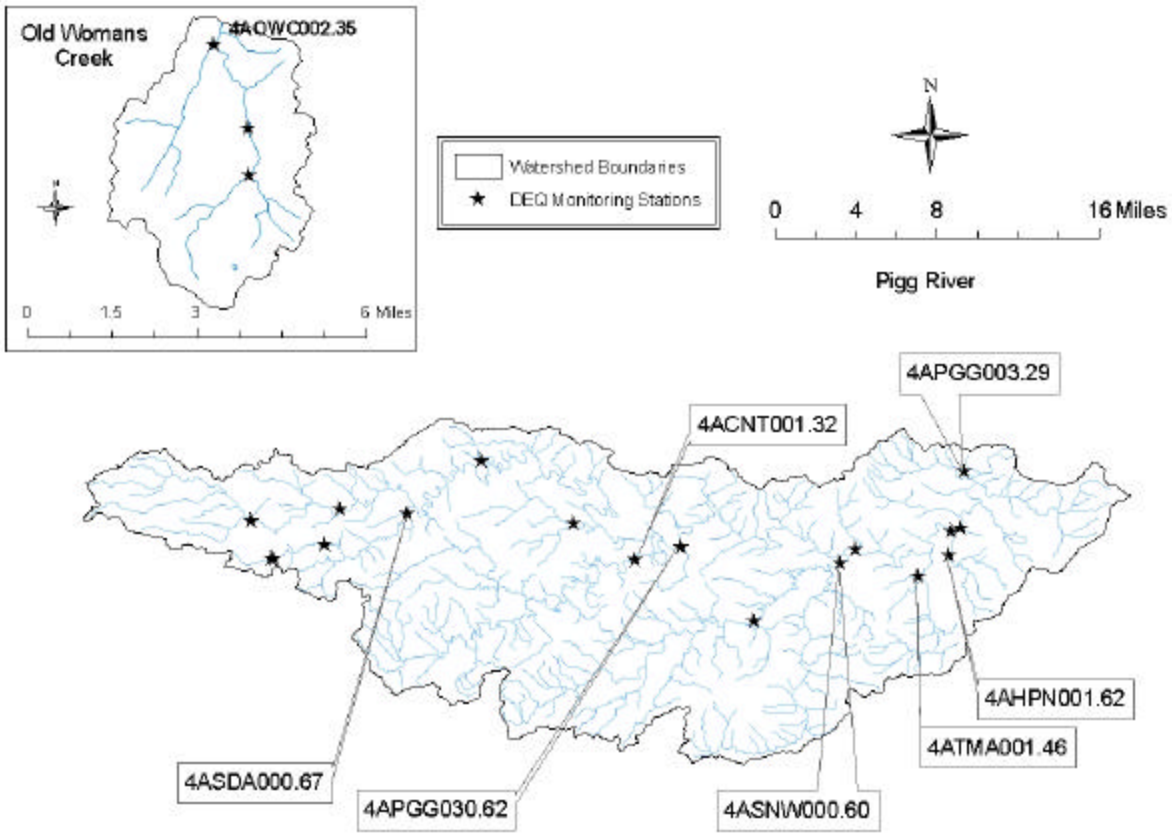

Figure 6.2. Location of Pigg River and Old Womans Creek TMDL Implementation Monitoring Stations.

6.6. Evaluation of Progress

During each annual evaluation of implementation progress on PR and OWC, a reassessment of implementation priorities will be made by the Steering Committee to readjust and fine-tune the targeting approach in concert with the staged implementation approach. Periodic re-evaluation is especially critical during these times of economic uncertainty, where increasing energy prices and fluctuating market prices are bound to affect stakeholders in the agricultural sector and their willingness to commit resources for conservation, especially if they are struggling to maintain their viability as a farming enterprise.

If reasonable progress toward implementing the management practices is not demonstrated, the Steering Committee will consider additional implementation actions. If it is demonstrated that

reasonable and feasible management measures have been implemented for a sufficient period of time and TMDL targets are still not being met, the TMDL will be reevaluated and revised accordingly. If after five years the Steering Committee determines that load reductions are being achieved as management measures are implemented, then the recommended appropriate course of action would be to continue management measure implementation and compliance oversight. If it is determined that all proposed control measures have been implemented, yet the TMDL is not achieved, further investigations will be made to determine whether: 1) the control measures are not effective; 2) bacteria loads are due to sources not previously addressed; or 3) the TMDL is unattainable.

7. STAKEHOLDERS' ROLES AND RESPONSIBILITIES

Stakeholders are individuals who live or have land management responsibilities in the watershed, including government agencies, businesses, private individuals, and special interest groups. Stakeholder participation and support is essential for achieving the goals of this TMDL effort (i.e., improving water quality and removing streams from the impaired waters list). The purpose of this chapter is to identify and define the roles of the stakeholders who will work together to put the IP into practice. The roles and responsibilities of some of the major stakeholders are described below.

7.1. Federal Government

USEPA has the responsibility of overseeing the various programs necessary for the success of the CWA. However, administration and enforcement of such programs falls largely to the states. The U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) is the federal agency that works hand-in-hand with US citizens to conserve natural resources on private lands. NRCS assists private landowners with conserving their soil, water, and other natural resources. Local, state and federal agencies and policymakers also rely on the expertise of NRCS staff. NRCS is also a major funding stakeholder for impaired water bodies through CREP and the Environmental Quality Incentive Program (EQIP). For more information on NRCS, visit http://www.nrcs.usda.gov/.

7.2. State Government

In the Commonwealth of Virginia, water quality problems are dealt with through legislation, incentive programs, education, and legal actions. Currently, there are five state agencies responsible for regulating and/or overseeing statewide activities that impact water quality in the Pigg River and Old Womans Creek watersheds.

Virginia Department of Environmental Quality (VADEQ): The State Water Control Law authorizes the State Water Control Board to control and plan for the reduction of pollutants impacting the chemical and biological quality of the State's waters resulting in the degradation of the swimming, fishing, shell fishing, aquatic life, and drinking water uses. For many years the focus of VADEQ's pollution reduction efforts was the treated effluent discharged into Virginia's waters via the VPDES permit process. The TMDL process has expanded the focus of VADEQ's pollution reduction efforts from the effluent of wastewater treatment plants to the NPS pollutants

causing impairments of the streams, lakes, and estuaries. The reduction tools are being expanded beyond the permit process to include a variety of voluntary strategies and BMPs.

VADEQ is the lead agency in the TMDL process. The Code of Virginia directs VADEQ to develop a list of impaired waters and develop TMDLs for these waters. VADEQ administers the TMDL process, including the public participation component, and formally submits the TMDLs to USEPA and the State Water Control Board for approval. VADEQ is also responsible for implementing point source WLAs, assessing water quality across the state, and conducting water quality standard related actions. The Code also requires the development of IPs for the TMDLs. VADEQ is providing funding for the development of this IP.

Virginia Department of Conservation and Recreation (VADCR): VADCR is authorized to administer Virginia's NPS pollution reduction programs in accordance with §10.1-104.1 of the Code of Virginia and §319 of the CWA. USEPA requires much of the §319 grant monies be used for the development of TMDLs. Because of the magnitude of the NPS component in the TMDL process, VADCR is a major participant in the TMDL process. VADCR has a lead role in the development of IPs to address correction of NPSs contributing to water quality impairments. VADCR also provides available funding and technical support for the implementation of NPS components of IPs. The staff resources in VADCR's TMDL program focus primarily on providing technical assistance and funding to stakeholders to develop and carry out IPs, and support to VADEQ in TMDL development related to NPS impacts. VADCR staff will also be working with other state agencies, Soil and Water Conservation Districts, and watershed groups to gather support and to improve the implementation of TMDL plans through utilization of existing authorities and resources.

Virginia Department of Agriculture and Consumer Services (VDACS): The VDACS Commissioner of Agriculture has the authority to investigate claims that an agricultural producer is causing a water quality problem on a case-by-case basis. If deemed a problem, the Commissioner can order the producer to submit an agricultural stewardship plan to the local soil and water conservation district. If a producer fails to implement the plan, corrective action can be taken, which may include civil penalties. The Commissioner of Agriculture can issue an emergency corrective action if runoff is likely to endanger public health, animals, fish and aquatic life, public water supply, etc. An emergency order can shut down all or part of an agricultural activity and require specific stewardship measures.

Virginia Department of Health (VDH): The VDH is responsible for maintaining safe drinking water measured by standards set by the USEPA. Like VDACS, VDH is complaint driven. Their duties also include regulation of septic systems, straight pipes, and biosolids land application. For TMDLs, VDH has the responsibility of enforcing actions to correct failed septic systems and/or eliminate straight pipes (Sewage Handling and Disposal Regulations, 12 VAC 5-610-10 et seq.).

Virginia Department of Forestry (VADOF): The VADOF has prepared a manual to inform and educate forest landowners and the professional forest community on proper BMPs and technical specifications for installation of these practices in forested areas (http://www.dof.virginia.gov/wq/index-BMP-Guide). Forestry BMPs are directed primarily to control erosion. For example, streamside forest buffers provide nutrient uptake and soil stabilization, which can benefit water quality by reducing the amount of nutrients and sediments that enter local streams. VADOF's BMP program is voluntary.

Another state entity with responsibilities for activities that impact water quality in the Pigg River and Old Womans Creek watersheds is the Virginia Cooperative Extension (VCE). VCE is an educational outreach program of Virginia's land grant universities (Virginia Tech and Virginia State University), and a part of the national Cooperative State Research, Education, and Extension Service, an agency of the United States Department of Agriculture. VCE is a product of cooperation among local, state, and federal governments in partnership with citizens. VCE offers educational programs and technical resources for topics such as crops, grains, livestock, poultry, dairy, natural resources, and environmental management. VCE has published several publications that deal specifically with TMDLs. For more information on these publications and to find the location of county extension offices, visit http://www.ext.vt.edu/.

7.3. Regional and Local Government

Regional and local government groups work closely with state and federal agencies throughout the TMDL process; these groups possess insights about their regional and local community that may help to ensure the success of TMDL implementation. These stakeholders have knowledge about a community's priorities, how decisions are made locally, and how the watershed's residents interact. Some local government groups and their roles in the TMDL process are listed below.

Blue Ridge (Franklin and Henry Counties) and Pittsylvania (Pittsylvania County) SWCDs: Soil and Water Conservation Districts (SWCDs) are local units of government responsible for the soil

and water conservation work within their boundaries. The districts' role is to increase voluntary conservation practices among farmers, ranchers and other land users. District staff work closely with watershed residents and have valuable knowledge of local watershed practices.

West Piedmont PDC: Planning District Commissions (PDCs) were organized to promote the efficient development of the environment by assisting and encouraging local governmental agencies to plan for the future. PDCs focus much of their efforts on water quality planning, which is complementary to the TMDL process.

Town of Rocky Mount: Local government staff members may work closely with PDCs and state agencies to develop and implement TMDLs in concert with their comprehensive plans. They may also help to promote education and outreach to citizens, businesses and developers to introduce the importance of the TMDL process.

Franklin and Pittsylvania Counties: County government staff members work closely with PDCs and state agencies to develop and implement TMDLs in concert with their comprehensive plans. They may also help to promote education and outreach to citizens, businesses and developers to introduce the importance of the TMDL process.

7.4. Businesses, Community Groups, and Citizens

While successful implementation depends on stakeholders taking responsibility for their role in the process, the primary role falls on the local groups that are most affected; that is, businesses, community watershed groups, and citizens.

Community Watershed Groups: (Leesville Lake Association, Creek Freak Paddlers of Franklin County, Virginia Save Our Streams, etc.) Local watershed groups offer a meeting place for river groups to share ideas and coordinate preservation efforts and are also a showcase site for citizen action. Watershed groups also have a valuable knowledge of the local watershed and river habitat that is important to the implementation process.

Citizens and Businesses: The primary role of citizens and businesses is simply to get involved in the TMDL process. This may include participating in public meetings, assisting with public outreach, providing input about the local watershed history, and/or implementing BMPs to help restore water quality.

Community Civic Groups: Community civic groups take on a wide range of community service including environmental projects. Such groups include the Ruritan, Farm Clubs, Homeowner

Associations and youth organizations such as 4-H and Future Farmers of America. These groups offer a resource to assist in the public participation process, educational outreach, and assisting with implementation activities in local watersheds.

Animal Clubs/Associations: Clubs and associations for various animal groups (e.g., beef, equine, poultry, swine, and canine) provide a resource to assist and promote conservation practices among farmers and other land owners, not only in rural areas, but in urban areas as well, where pet waste has been identified as a source of bacteria in water bodies. Virginia's approach to correcting non-point source pollution problems continues to be encouragement of participation through education and financial incentives; that is, outside of the regulatory framework. If, however, voluntary approaches prove to be ineffective, it is likely that implementation will become less voluntary and more regulatory.

8. INTEGRATION WITH OTHER WATERSHED PLANS

Each watershed within the state is under the jurisdiction of a multitude of individual yet related water quality programs and activities, many of which have specific geographical boundaries and goals. These include, but are not limited to, Total Maximum Daily Loads, water quality management plans (WQMPs), sediment and erosion control regulations, stormwater management (SWM), Source Water Assessment Program (SWAP), and local comprehensive plans.

8.1. Continuing Planning Process

According to Perciasepe (1997) the continuing planning process (CPP) established by Section 303(e) of the CWA provides a good framework for implementing TMDLs, especially the NPS load allocations. Under the Section 303(e) process, states develop and update statewide plans that include TMDL development and adequate implementation of new and revised water quality standards, among other components. The water quality management regulations at 40 CFR 130.6 require states to maintain WQMPs that are used to direct implementation of key elements of the continuing planning process, including TMDLs, effluent limitations, and NPS management controls. These state WQMPs are another way for states to describe how they will achieve TMDL load allocations for NPSs. The CPP in Virginia is implemented in various state programs, all aimed toward achieving and maintaining the state water quality standards. Virginia Code Sections 62.1-44.15(10) & (13), 62.1-44.17:3, and 62.1-44.19:7 give the Virginia State Water Control Board (Board) the duty and authority to conduct the CPP in Virginia. Under the authority of Virginia Code Section 10.1-1183, VADEQ serves as the administration arm of the Board. Virginia WQMPs consist of initial plans produced in accordance with Sections 208 and 303(e) of the CWA and approved updates to the plans. Currently, Virginia has a total of 18 WQMPs developed under Sections 208 and 303(e). Many of these plans are outdated, and efforts are underway to update them. The updated plans will serve as repositories for all TMDLs approved by USEPA and adopted by the Board, as well as IPs approved by the Board.

8.2. Watershed and Water Quality Management Planning Programs in Virginia

TMDLs – TMDLs are the maximum amount of pollutant that a water body can assimilate without surpassing state water quality standards. TMDLs are developed for water bodies that are listed on a state's 303(d) list, known as the "Impaired Waters List." The TMDL develops a waste load

allocation for point sources and a load allocation for NPSs and incorporates a "margin of safety" in defining the assimilation capacity of the water body. The IP outlines strategies to meet the allocations.

WQMPs – Water Quality Management Plans (WQMPs) are produced and updated by VADEQ in accordance with Sections 208 and 303(e) of the CWA as outlined in the CPP section above. These plans will be the repository for TMDLs and TMDL IPs.

SWM – Stormwater Management (SWM) programs are implemented according to the Virginia Stormwater Management Law and Virginia Stormwater Management Regulations (VSWML&R). These statutes are specifically set forth regarding land development activities to prevent water pollution, stream channel erosion, depletion of ground water resources, and more frequent localized flooding to protect property values and natural resources. SWM programs operated according to the law are designed to address these adverse impacts and comprehensively manage the quality and quantity of stormwater runoff on a watershed-wide basis. VADCR oversees regulated activities undertaken on state and federal property, while localities have the option to establish a local program to regulate these same activities on private property in their jurisdiction. For more information, visit http://www.DCR.state.va.us/sw/stormwat.htm.

SWAP – Section 1453 of the 1986 Amendments of the Safe Drinking Water Act (SDWA) requires each state to develop a Source Water Assessment Plan (SWAP) that will delineate the boundaries of the assessment areas from which public water systems receive drinking water using hydrogeologic information, water flow, recharge, and discharge and other reliable information. The VDH is the primary agency for drinking water and is therefore responsible for SWAP. In Virginia, all 187 surface water intakes serving 151 public waterworks have completed surface water assessments. All 4,584 ground water source assessments, serving nearly 4,000 public waterworks, were completed by the end of 2003.

Local Comprehensive Plans – (Franklin and Pittsylvania Counties) Virginia state law requires all local governments have an adopted comprehensive plan. Typical topics addressed in a comprehensive plan include the analysis of population change, land use and trends, natural and environmental features, transportation systems, and community facilities and services. Local comprehensive plans should be referred to in the TMDL development process as well as TMDL implementation, especially for urbanized watersheds.

9. POTENTIAL FUNDING SOURCES

Canaan Valley Institute Small Grants Program – Canaan Valley Institute (CVI) seeks to support local stakeholder organizations committed to restoring and protecting the natural resources of their watersheds. Therefore, applications must address water quality or quantity issues or aquatic habitat. CVI encourages groups to submit projects that can show quantifiable/measurable outcomes. Priority will be given to projects that address wastewater, source water, flooding, stream restoration, or conservation planning that addresses water resources. Groups seeking organizational development funding such as watershed awareness can apply for up to $2,000; specific projects such as watershed assessments, restoration planning, project designs or implementation can apply for up to $5,000. Projects must be completed within two years.

Clean Water State Revolving Fund – USEPA awards grants to states to capitalize their Clean Water State Revolving Funds (CWSRFs). The states, through the CWSRF, make loans for high-priority water quality activities. As loan recipients make payments back into the fund, money is available for new loans to be issued to other recipients. Eligible projects include point source, NPS, and estuary protection projects. Point source projects typically include building wastewater treatment facilities; combined sewer overflow and sanitary sewer overflow correction; urban stormwater control; and water quality aspects of landfill projects. NPS projects include agricultural, silviculture, rural, and some urban runoff control; on-site wastewater disposal systems (septic tanks); land conservation and riparian buffers; leaking underground storage tank remediation, etc.

Conservation Reserve Enhancement Program – The Conservation Reserve Enhancement Program (CREP) is a voluntary land retirement program that helps agricultural producers protect environmentally sensitive land, decrease erosion, restore wildlife habitat, and safeguard ground and surface water. CREP is an offshoot of the country's largest private-lands environmental improvement program -- the Conservation Reserve Program (CRP). Like CRP, CREP is administered by USDA's Farm Service Agency (FSA). CREP addresses high-priority conservation issues of both local and national significance, such as impacts to water supplies, loss of critical habitat for threatened and endangered wildlife species, soil erosion, and reduced habitat for fish populations such as salmon. CREP is a community-based, results-oriented effort centered on local participation and leadership. CREP contracts require a 10- to 15-year

commitment to keep lands out of agricultural production. A federal annual rental rate, including an FSA state committee-determined maintenance incentive payment, is offered, plus cost-share of up to 50 percent of the eligible costs to install the practice.

Environmental Quality Incentives Program – The USDA Natural Resources Conservation Service's Environmental Quality Incentives Program (EQIP) was established to provide a voluntary conservation program for farmers and ranchers to address significant natural resource needs and objectives. EQIP offers financial and technical help to assist eligible participants install or implement structural and management practices on eligible agricultural land.

EPA 319 Grant Incremental Funds – Through Section 319 of the Federal CWA, Virginia is awarded grant funds to implement NPS programs. VADCR administers the money to fund watershed projects, demonstration and educational programs, NPS pollution control program development, and technical and program staff including TMDL Implementation. During implementation in the PR and OWC watersheds, standards, specifications, cost-share, and tax credits for practices under the Virginia Agricultural BMP Cost-share Program will be followed for funding eligibility. Section 319 funds should be available at the completion of the IP, and in subsequent years during implementation, given reasonable progress toward implementation goals.

Five-Star Restoration Program – The USEPA supports the Five-Star Restoration Program by providing funds to the National Fish and Wildlife Foundation and its partners, the National Association of Counties, NOAA's Community-based Restoration Program, and the Wildlife Habitat Council. These groups then make subgrants to support community-based wetland and riparian restoration projects. Competitive projects will have a strong on-the-ground habitat restoration component that provides long-term ecological, educational, and/or socioeconomic benefits to the people and their community. Preference will be given to projects that are part of a larger watershed or community stewardship effort and include a description of long-term management activities. Projects must involve contributions from multiple and diverse partners, including citizen volunteer organizations, corporations, private landowners, local conservation organizations, youth groups, charitable foundations, and other federal, state, and tribal agencies and local governments. Each project would ideally involve at least five partners who are expected to contribute funding, land, technical assistance, workforce support, or other in-kind services that are equivalent to the federal contribution.

Landowner Incentive Program (Non-Tribal) – The U.S. Fish and Wildlife Service's Landowner Incentive Program (LIP) grant program provides competitive matching grants to states, territories, and the District of Columbia to establish or supplement landowner incentive programs. LIP is a grant-based voluntary cost-share program administered by Virginia Department of Game and Inland Fisheries. These programs provide technical and financial assistance to private landowners for projects that protect and restore habitats of listed species or species determined to be at-risk. LIP projects will likely involve activities such as the restoration of marginal farmlands to wetlands, the removal of exotic plants to restore natural prairies, a change in grazing practices and fencing to enhance important riparian habitats, instream structural improvements to benefit aquatic species, road closures to protect habitats and reduce harassment of wildlife, and acquisition of conservation easements. Although not directly eligible for these grants, third parties such as nonprofit organizations may benefit from these funds by working directly with their states to see if either grants or partnering opportunities are available. Private landowners within the Roanoke River Basin (including the Pigg River, Old Womans Creek, and all tributaries) are eligible for program benefits.

Southeast Rural Community Assistance Project (SE/R-CAP) – The mission of this project is to promote, cultivate, and encourage the development of water and wastewater facilities to serve low-income residents at affordable costs and to support other development activities that will improve the quality of life in rural areas. Staff members of other community organizations complement the SE/R-CAP central office staff across the region. They can provide (at no cost to a community): on-site technical assistance and consultation, operation and maintenance/management assistance, training, education, facilitation, volunteers, and financial assistance. Financial assistance includes $1,500 toward repair/replacement/installation of a septic system and $2,000 toward repair/replacement/installation of an alternative waste treatment system. Funding is only available for families making less than 125% of the federal poverty level. The federal poverty threshold for a family of four is $18,850.

Virginia Aquatic Resources Trust Fund (VARTF) – The Virginia Aquatic Resources Trust Fund is administered in partnership with The Nature Conservancy and the United States Army Corps of Engineers Norfolk District. The Trust Fund helps make large-scale conservation possible. The program is able to implement large-scale watershed efforts that restore, enhance, and protect water quality through cost-effective, ecologically preferable projects.

Virginia Agricultural Best Management Practices Cost-Share Program – The Virginia Agricultural Best Management Practices (BMPs) Cost-Share Program provides funds to help install conservation practices that protect water and make farms more productive. Funding availability varies by SWCD. The state provides SWCDs with funds to target areas with known water quality needs. Areas with the greatest need receive the greatest funding. The cost-share program supports using various practices in conservation planning to treat animal waste, cropland, pastureland and forested land. Some are paid for at a straight per-acre rate. Others are cost-shared on a percentage basis up to 75 percent. In some cases, USDA also pays a percentage. In fact, the cost-share program's practices can often be funded by a combination of state and federal funds, reducing the landowner's expense to less than 30 percent of the total cost. Cost-share funds are also available for approved innovative BMP demonstration projects intended to improve water quality.

Virginia Agricultural Best Management Practices Loan Program – The Virginia Agricultural Best Management Practices Loan Program provides a source of low interest financing which will encourage the use of specific best management practices which reduce or eliminate the impact of Agricultural Nonpoint Source (NPS) pollution to Virginia's waters. VADEQ's Virginia Ag BMP loan program is a subset of the parent Virginia Clean Water Revolving Loan Fund (VCWRLF) loan program and is intended to create a continuing source of low interest financing that will be available to Virginia's agricultural producers to assist them in their efforts to reduce agricultural non-point source pollution. Unlike other assistance programs, the Ag BMP loan program is not dependent on legislative appropriations for its fund availability. All repayments of principle and interest from previous Ag BMP loans are returned to the Fund and used to provide additional loans to other Virginia farmers. In addition to the revenue available from repayments, VADEQ will request that the State Water Control Board (SWCB) consider making additional funding set-asides from the VCWRLF revenue as deemed necessary in order to meet Virginia's agricultural non-point source pollution reduction needs.

Virginia Agricultural Best Management Practices Tax Credit Program - For all taxable years, any individual or corporation, who is engaged in agricultural production for market and who has in place a soil conservation plan approved by the local SWCD, is allowed a credit against the tax imposed by Section 58.1-320 of an amount equaling 25% of the first $70,000 expended for agricultural best management practices by the individual. The amount of the credit cannot exceed $17,500 or the total amount of the tax imposed by this program (whichever is less) in the year the project was completed. This program can be used independently or in conjunction

with other cost-share programs on the stakeholder's portion of BMP costs. It is also approved for use in supplementing the cost of repairs to streamside fencing.

Virginia Environmental Endowment – The Virginia Mini-Grant Program supports community-based efforts to strengthen environmental education and to promote stewardship of Virginia's waterways. Preference is given to modest local projects. Public and private schools (K-12) and nongovernmental, nonprofit community organizations in Virginia are eligible to apply for one-year Mini-Grant awards up to $5,000. Local, state, and federal government agencies and programs are not eligible.

Virginia Open-Space Lands Preservation Trust Fund – Farmland, forest land, and open space land are important to our heritage in Virginia. These lands are under increasing pressure from urban development in parts of the Commonwealth. The 1997 Virginia General Assembly created a new fund (Va. Code Sections 10.1801-2) to assist landowners with the costs of conveying conservation easements and the purchase of all or part of the value of the easements. The fund is operated by the Virginia Outdoors Foundation. Conservation easements preserve farmland, forestland, and natural and recreational areas by restricting intensive uses, such as development and mining, which would alter the conservation values of the land. An easement is a voluntary legal agreement between a landowner and a public body or conservation group in which the parties agree to protect the open-space and natural resource values of the land. Each easement is tailored to reflect the conservation values of the property and is recorded in the local courthouse as a permanent part of the property records. Easements do not grant public access to a landowner's property. Costs that the fund may reimburse include legal costs, appraisal and other costs, and all or part of the easement's value. To be eligible, the easement must be perpetual in duration. Additional information is available at http://www.virginiaoutdoorsfoundation.org/VOF_land-ptf.php.

10. REFERENCES

EPA-CBP. 2008. Agricultural BMP effectiveness estimates. Available at: archive.chesapeakebay.net/pubs/Final Ag Efficiencies.doc. Accessed: 28 January 2009.

EPA-CBP. 2003. Chesapeake Bay Program Phase 4.3 Watershed Model nonpoint source BMPs (12/22/03). Available at: www.chesapeakebay.net/pubs/waterqualitycriteria/CBWS_model_BMP.doc. Accessed: 28 January 2009.

MapTech, Inc. 2006. Water quality implementation plan for Blacks Run and Cooks Creek (Fecal coliform and Aquatic Life TMDLs). Prepared in coordination with the Virginia Department of Conservation and Recreation and the Virginia Department of Environmental Quality. May 25, 2006. Available at: www.deq.state.va.us/tmdl/iprpts.html. Accessed: 28 January 2009.

Perciasepe, Robert. 1997. New Policies for Establishing and Implementing Total Maximum Daily Loads (TMDLs). Memorandum sent August 8, 1997. Washington, D.C.: U.S. Environmental Protection Agency.

SWCB. 2003. 9VAC25-260-10. Designation of uses. Available at: leg1.state.va.us/cgi-bin/legp504.exe?000+reg+9VAC25-260-10. Accessed: 28 January 2009.

USDA-NRCS. 2007. Virginia Average Cost List for FY08. Available at: efotg.nrcs.usda.gov/references/public/VA/Average_Cost_List_FY08.pdf. Accessed: 28 January 2009.

VCE. 2000. Feeder and stock health and management practices, by John F. Currin and W. D. Whittier, Extension Specialists, Virginia-Maryland Regional College of Veterinary Medicine, Virginia Tech. Publication Number 400-006. January 2000. Available at: www.ext.vt.edu/pubs/beef/400-006/400-006.html. Accessed: 28 January 2009.

VCE. 1998a. Safe water for horses, questions about water testing, by Larry Lawrence, Extension Animal Scientist, Horses, Animal and Poultry Sciences, Virginia Tech. Livestock Update. December 1998. Available at: www.ext.vt.edu/news/periodicals/livestock/aps-98_12/aps-1005.html. Accessed: 28 January 2009.

VCE. 1998b. Mastitis cost? by Gerald M. (Jerry) Jones, Extension Dairy Scientist, Milk Quality and Milking Management, Virginia Tech. Dairy Pipeline. December 1998. Available at: www.ext.vt.edu/news/periodicals/dairy/1998-12/mastitis$.html. Accessed: 28 January 2009.

VCE. 1998c. Understanding the Basics of Mastitis, by G.M. Jones, Extension Dairy Scientist, Milk Quality and Milking Management, Virginia Tech and T.L. Bailey, Jr., Extension Veterinarian, Department of Large Animal Clinical Sciences, Virginia-Maryland College of Veterinary Medicine, Virginia Tech. Publication Number 404-233. April 1998. Available at: www.ext.vt.edu/pubs/dairy/404-233/404-233.html. Accessed: 28 January 2009.

VCE. 1996. Controlled grazing of Virginia's pastures, by Harlan E. White and Dale D. Wolf, Virginia Cooperative Extension Agronomists; Department of Forages, Crop, and Soil Environmental Sciences, Virginia Tech. Publication Number 418-012. July 1996. Available at: www.ext.vt.edu/pubs/livestock/418-012/418-012.html. Accessed: 28 January 2009.

Zeckoski, R., B. Benham, and C. Lunsford. 2007. Streamside livestock exclusion: A tool for increasing farm income and improving water quality. VCE Publication No. 442-766. Virginia Cooperative Extension. Available at: www.ext.vt.edu/pubs/bse/442-766/442-766.pdf. Accessed: 28 January 2009.

APPENDIX A. STEERING, WORKING GROUP, AND PUBLIC MEETING SUMMARIES

Minutes from Informational Meeting held on May 1, 2008 at The Franklin Center, Rocky Mount, VA:

Attendees: David Vogelsong (Franklin Co.), Kathy Smith (BRSWCD), Jack O'Connell (USDA/NRCS), John P. Myers (PSWCD), PW Morgan (BRSWCD), Michael Tabor (BRSWCD), Eddie Wells (Roanoke Valley Alleghany Regional Commission), Beverly Cox (VCE), Doug Phillips (SERCAP, Inc.), Adam Carter (VDH), Paula Nash (DEQ SCRO), Krystal Coxon (DCR), Karen Kline (V T BSE), Mary Dail (DEQ WCRO)

Welcome and introductions: Mary Dail, Department of Environmental Quality, welcomed attendees and each person introduced him or herself.

Overview of the Cleanup/Implementation Plan Development:

- Dail explained the purpose of the meeting as gauging interest of key stakeholders in Franklin and Pittsylvania counties regarding the development of a watershed cleanup plan for the Pigg River and Old Womans Creek watersheds.
- Dail described the TMDL process including the pollutant reductions needed in stage one and final implementation of the cleanup/implementation plan for the Pigg River and Old Womans Creek watersheds.
- Dail explained the public involvement component of developing the cleanup plan that includes public meetings, working groups and a steering committee. She recommended that there be two agricultural working groups, one for each county, and possibly two residential working groups, one for each county.
- Dail provided a brief account of the Roanoke logperch habitat restoration project and the removal of Power Dam on the Pigg River. She will keep in touch with William Hester of US Fish and Wildlife Service on this project.
- Dail discussed the steps of developing corrective actions, conducting a cost/benefit analysis and establishing measurable goals and a timeline. She noted that both the Pittsylvania Soil and Water Conservation District (PitSWCD) and the Blue Ridge Soil and Water Conversation District (BRSWCD) have already started implementing corrective actions within the watersheds and asked for updates from both Districts.
- John Myers of PitSWCD reported that 10-12 corrective actions were approved and four installed along the tributaries in the watersheds. The corrective actions include stream exclusion and alternative watering systems. Myers reported that one waste management facility was approved on the main stem of the Pigg River.
- PW Morgan and Michael Tabor of BRSWCD reported that 16 grazing land protection with stream exclusion (SL-6) corrective actions and one animal waste control facility (WP-4) are planned along tributaries in the watersheds. As of January 2007, three corrective actions are installed at a cost of $95,250 with 3.8 miles of stream exclusion.
- Morgan also mentioned that corrective actions were placed on a dairy operation above Waid Park using money from US Fish & Wildlife Service.
- Tabor said that landowners advertise the cost-share program. Once practices are in place landowners tell friends about the success of the program.
- Morgan said that the first two years of implementing the Blackwater watershed cleanup plan yielded little progress.
- Morgan stated that BRSWCD had received a $500,000 grant for the Pigg River cleanup project and an employee. The employee has been transferred to a different SWCD and BRSWCD is asking for another $500,000 grant to continue the work and another employee to help
- Jack O'Connell of the Natural Resources Conservation Service reported that three Conservation Reserve Program (CRP) projects were installed for a total of 3 miles of stream exclusion along tributaries in the Snow Creek subwatershed of the Pigg River watershed.

- Morgan asked who decides which practices (corrective actions) are used. Dail responded that the cleanup plan (implementation plan) process decides. Karen Kline of Virginia Tech Center for Watershed Studies responded that working groups make recommendations regarding practices.
- Morgan said that permanent vegetative cover on critical areas (SL-11) is needed in the Pigg River watershed.
- Myers said that landowners want to plant trees instead of installing fences along streams.
- Adam Carter of the Virginia Department of Health said that his organization investigates straight pipes through a complaint driven process. He said they have found straight pipes at older homes in Boones Mill. Dail stated that straight pipes are often underestimated in TMDL studies.
- Tabor said that the cost-share program provides 50 percent reimbursement up to $4,000 with a sliding scale up to 75 percent based on economic need.
- Doug Phillips of SERCAP said that state funds are used to subsidize work with wells and septic systems based on economic need. The program only operates in rural areas.

Questions and Comments: Dail opened the meeting to questions and asked attendees to provide information about local interest in developing a plan, potential obstacles to implementing a plan and partners and participants for public involvement.

Agricultural Corrective Actions

- Regarding agricultural corrective actions, the work done to date by the Blue Ridge and Pittsylvania Soil and Water Conservation Districts shows that there is interest among residents to participate in implementation.
- Many residents have participated in the Blackwater watershed cleanup plan (implementation plan).
- Morgan said that an obstacle to implementing agricultural corrective actions is that the 35-foot buffer requirement for stream exclusion is difficult for some landowners because of steep grade and loss of pasture land / grazing land.
- Myers said that the 35-foot buffer requirement is not a deal breaker. He added that unlike the Natural Resources Conservation Service program, the Department of Conservation and Recreation cost-share program allows projects to be implemented by field instead of by track of land.
- Myers said that an obstacle to implementing agricultural corrective actions is that 75 percent cost-share is not enough for some landowners.
- Morgan added that it is important for landowners to contribute some money to a corrective action to feel ownership in the project.

Residential Corrective Actions

- Carter said that residents in Franklin County who live within 500 feet of Smith Mountain Lake are mandated to pump out septic systems every 3 – 5 years. Gray water must be tied into the system.
- Carter said that one obstacle to residential corrective actions is that some homeowners don't know that septic systems must be pumped out and may not be aware of the consequences if a septic system is not pumped out.
- He added that another obstacle to the program is competing priorities of cost of gas, food, housing, etc. that leaves little money left to pay for corrective actions.
- Carter would like to see the septic system pump out mandate to expand to all homeowners with septic in the Pigg and Blackwater watersheds.
- Carter said that if land won't percolate for a standard septic system, an alternate system must be installed. He added that permit fees for a standard septic system are $275.00 and if an alternate system must be installed an engineer must be hired, which can cost thousands of dollars.

- Tabor added that they stay away from installing alternative systems because they are too expensive.
- For implementation of the Blackwater watershed cleanup plan, the standard cost-share amount is 50 percent with a scale up to 75 percent based on economic need.
- An obstacle for septic system maintenance is that in some subdivisions, drainfields are located on lots separate from the homeowner's lots.
- Carter said that some soils limit drainfield location.

Next Steps:

- Dail suggested June 3rd or 5th as the date for the 1st public meeting and asked attendees to contact her if they had a conflict with either date.
- The following locations were suggested for public meetings:
    - The Franklin Center
    - Snow Creek Christian Church
    - Snow Creek Elementary School
- Tabor said he might be able to provide food because he has a public meeting budget.
- Residents may be contacted by the following means:
    - FSA newsletter
    - Blue Ridge Soil and Water Conservation District newsletter
    - Advertisements in local newspapers (Franklin News Post, Star Tribune, Roanoke Times)
    - Word of mouth
    - Local radio stations
    - Mass mailing if funding is available
        - Myers said that they tried a mass mailing and didn't have much success.
    - Sandwich signs at bridge crossings
    - Community calendar (all counties)
- Wednesday nights and Virginia Tech football game nights should be avoided for night meetings.
- Meeting start time should be 7:30 p.m.
- Dail asked the Soil and Water Conservation District representatives to co-facilitate the agricultural working group meetings with Coxon.
- Dail walked attendees through the handouts.

Minutes from 1st Public Meeting held on June 5, 2008 at The Franklin Center, Rocky Mount, VA:

Attendees: Kathy Smith (Blue Ridge Soil and Water Conservation District, BRSWCD), John P. Myers (Pittsylvania Soil and Water Conservation District, PitSWCD), Eddie Wells (Roanoke Valley Alleghany Regional Commission), William Hester (U.S. Fish & Wildlife Service, USFWS), Christy Straight (Upper Roanoke River Roundtable), Dick Cole (Virginia Save Our Streams, VASOS), Larry Hutson (Smith Mountain Lake Association), Gene Yagow (VT BSE), Krystal Coxon (DCR), Karen Kline (VT BSE), Mary Dail (DEQ WCRO)

Welcome and introductions: Mary Dail, Department of Environmental Quality, welcomed attendees and each person introduced him or herself.

Overview of the Cleanup/Implementation Plan Development:

- Dail explained the purpose of the meeting as providing information on how to develop a watershed cleanup plan for the Pigg River and Old Womans Creek watersheds.
- Dail described the TMDL process including a review of the Pigg River and Old Womans Creek TMDL development and the status of water quality in the watersheds.
- Karen Kline (VT BSE) provided a brief discussion of the sources of bacteria in the watersheds and how they are distributed. She then presented the pollutant reductions needed in stage one and final implementation of the cleanup/implementation plan for the Pigg River and Old Womans Creek watersheds.
- Kline discussed the steps of developing corrective actions, conducting a cost/benefit analysis and establishing measurable goals and a timeline.
- Dail explained the public involvement component of developing the cleanup plan that includes public meetings, working groups and a steering committee. She described the responsibilities of agricultural, residential and governmental working groups and the steering committee.
- Dail expressed that local citizen input is critical during the development of the cleanup plan. She presented a timeline to be used as a guide for developing the plan.

Pledge Cards: Krystal Coxon (DCR) described the "Make a Pledge for Clean Water in the Pigg River" pledge cards and how they can be used as a tool to motivate individuals to action that contributes to clean water. She suggested they be provided to stakeholders at public meetings and/or working group meetings.

Questions and Comments: Dail opened the meeting to questions and asked attendees to provide information about potential obstacles to implementing a plan, and how to increase participation and public involvement in the development of a cleanup plan.

- Kathy Smith (BRSWCD) asked how straight pipes could be identified in the watersheds. Dail said that it will be important to communicate that the goal is water quality, not enforcement. She followed up saying that soil and water conservation districts will be integral partners to working with landowners. Gene Yagow (VT) said that there are many categories to understand the audience. For example, some people know they have a straight pipe and others don't know so education is key. Smith added that word-of-mouth will be important to reaching people.
- Dick Cole (VASOS) would like to see success stories from other watersheds.
- Dail commented on the low attendance of stakeholders at the meeting and asked for suggestions on how to increase stakeholder involvement in the cleanup process. She had advertised the meeting through press releases to local newspapers, radio stations, and cable television stations. John Myers (PitSWCD) stated that most residents of the watershed don't have access to cable television.
- William Hester (USFWS) provided a report on the USFWS' interest in improving the habitat for Roanoke Logperch in the Pigg River. He reported that the Ward Burton Wildlife Foundation has taken the lead on developing a contract for an environmental assessment of the Power Dam. He also reported that USFWS and AEP are coming close to an agreement on studies of the Roanoke

Logperch in the Pigg River near Leesville Lake. USFWS is providing cost share monies within the Pigg River watershed and has had success with implementation of fencing and riparian buffers along the stream on a dairy operation in Franklin County. USFWS is interested in partnering with DEQ in matching state funding with federal funding for BMPs in the watershed.

- Smith provided a report of current BRSWCD activities in the Pigg River watershed. BRSWCD is in the process of hiring a conservation specialist who will focus on BMPs in the watershed. She reported that 16 grazing land protection with stream exclusion (SL-6) corrective actions and one animal waste control facility (WP-4) are planned along tributaries in the watersheds. To date, $95,250 has been paid out in cost share monies, 5.9 miles of fencing has been installed with 4 miles of stream exclusion. BRSWCD is requesting another $500,000 grant through DCR to continue the work over the next two years. Natural Resources Conservation Service (NRCS) is in agreement to provide cost share money and provide technical assistance. Myers stated that NRCS is also providing those services for the Pittsylvania County portion of the watersheds.
- Myers provided a report of current PitSWCD activities in the Pigg River and Old Womans Creek watersheds. He reported that even though participation from local farmers was low because of the drought, contracts have been approved for WP-2T and SL-6 practices within the watersheds. A grant has been extended to continue work for two more years and CREP will be available once the implementation plan is completed. Myers is working with DGIF to provide cost share programs to farmers (up to 90%). Landowners who have installed BMPs have had much success, such as increased weight gain in herds within a year and the need for less hay with rotational grazing.

Next Steps:

- Dail asked for strategies to create the working groups.
- Testimonials were suggested, landowners have to know what's in it for them.
- Mass mailing may be effective for residential groups if funding is available.
- Articles in newspapers (Chatham, Franklin, and Danville) will increase awareness of the project.
- Cole suggested getting more people involved in VASOS.
- Hester suggested having a Web site with information about the project. Dail and Kline mentioned that Virginia Tech is hosting a Web site with information about the project. Dail will link this Web site to the DEQ Web site so that it is easier to access.
- Information can be presented at the following upcoming events: Southwest Virginia Antique Farm Days, Pigg River Ramble, Smith Mountain Lake Water Fair (June 22).

Minutes from Residential Working Group Meeting held on August 14, 2008 at The Franklin Center, Rocky Mount, VA:

Attendees: Brian Benham (VT BSE), Jim Bier (Watershed Resident), Adam Carter (Virginia Department of Health, VDH), Tony Goff (Blue Ridge Soil and Water Conservation District, BRSWCD), Katie Jordan (Ferrum College), Jackie Lindsey (Virginia Roanoke River Basin Advisory Committee, VRRBAC), John Lindsey (VRRBAC), Carol Love (Creek Freaks), Scott Martin (Franklin County), Doug Phillips (Southeast Rural Community Assistance Project, SERCAP), Bill Reidenbach (Citizen), Dan Richardson (VDH), Roger Seale (BRSWCD), Morris Stephenson (*The Franklin News-Post*), Jared Webb (Earth Environmental Consultants), Raymond Williams (Creek Freaks), Nathan Wright (Town of Rocky Mount), Karen Kline (VT BSE), Mary Dail (DEQ WCRO)

Welcome and introductions: Mary Dail, Department of Environmental Quality, welcomed attendees and each person introduced him or herself.

Overview of the Cleanup/Implementation Plan Development:

- Dail discussed DEQ's water quality monitoring data within the Pigg River and Old Womans Creek watersheds. The data showed levels of bacteria that exceed the state's Water Quality Standards at some of the monitoring sites, therefore impaired segments within the watershed were placed on the 303(d) Impaired Waters List ("Dirty Waters" list)
- Dail provided a review of the development of bacteria TMDLs for the watersheds. She presented the required bacteria reductions needed within the watersheds to meet the Water Quality Standards.
- Dail explained the purpose of the meeting was to obtain feedback on residential issues that will affect the development of a Cleanup Plan.

General Questions:

General questions about the Clean-up Plan or Working Groups

Someone asked if some of the sources of pollution requiring reductions are illegal. Dail answered yes, and that the topic of straight pipes would be covered during the meeting. A handout was distributed showing the estimated number of potential straight pipes and failing septic systems throughout the watersheds.

How receptive did you think the general public is to a Clean-up Plan for the watersheds?

- Interest will be reflected in the density of the population. A comparison was made between the Blackwater River watershed with a high density population and the Pigg River and Old Womans Creek watersheds with a more rural population. Implementation of the Blackwater Clean-up Plan has been doing well, but we may not see the same level of involvement in these watersheds.
- Someone asked for more information on the bacterial source tracking (BST) data for the watersheds. Dail passed around a handout of the BST results for the six stations in the Pigg River watershed and the one station in the Old Womans Creek watershed. The group discussed the results and how they affect the clean-up plan. It was noted that the BST results show that the bacteria from pet and human sources was considerably lower than bacteria from livestock and wildlife at all of the stations.
- Representatives from BRSWCD were asked how fencing cattle out of streams affected the contribution of bacteria from wildlife sources. Roger Seale responded that wildlife would probably increase in the fenced riparian area, and further monitoring will show how the increased wildlife will affect water quality. At this time, water quality monitoring has shown that there is a decreasing trend in bacteria levels in the Blackwater River watershed since the installation of cattle exclusion fencing.

While the Clean-up Plan will focus on reducing bacteria; are there any other water quality or pollution concerns that should be kept in mind when developing the plan?

A question was asked as to what residents can do to implement the plan. A representative from Creek Freaks stated that their group would be willing to help (e.g., identifying potential sources of bacteria while on float trips).

Bacteria Reduction Strategies:

Identify and fix straight pipes and failing septic systems.

- The question was asked as to how to enforce actions to eliminate straight pipes and correct failed septic systems. Adam Carter responded that VDH does enforce the elimination of straight pipes when a complaint is filed, but they do not have the resources to canvas the whole area.
- Seale mentioned that there is currently no cost-share money available for residential best management practices (BMPs). There may be some available once the clean-up plan is finished.
- It was suggested that there is a need to develop awareness and conscientiousness in the community to get people to replace straight pipes and repair failing septic systems. Dail asked what the best way to raise awareness is. Response: Money is an issue for straight pipe/failing septic system repair, and some households don't have space for a septic system.
- Seale suggested identifying and targeting houses close to the stream using tax maps.
- Doug Phillips stated that SERCAP has resources (e.g., low-interest loans) for new construction or system upgrades of wastewater facilities in rural communities.
- Seale recommended door-to-door marketing (e.g., leaving a brochure/flyer at each house) letting households know what resources are available for repairing or adding a septic system. Also, FSA newsletters, mailings, radio announcements, and Cable 12 can be used to get information to the public.
- Brian Benham suggested that the general public has moved from resisting/questioning BMPs to apathy toward improving water quality in the streams. He asked how we reach people a different way. Response was that we have to reach people on a value level, give them a personal reason for improving water quality. An example is stream-side fencing to exclude cattle from the stream has resulted in benefits to the cattle and farmer.
- Dail explained that given the State's current budget, we shouldn't count on Section 319 funds. We will have to rely on SERCAP and other sources.
- Carter asked if estimation of costs written into the plan will also include estimates for well-drilling. Seale responded that the Blackwater River TMDL Clean-up Plan did not cover the costs of well-drilling. SERCAP may have money for wells.
- Dail asked if people in watersheds know that they have to maintain their septic systems. Benham asked how community would react to mandatory septic pump-outs. Dan Richardson responded that the only way supervisors would consider this would be if the pump-outs were required with the sale of a property. On average home owners move houses every seven years. Group discussion led to a consensus that the Franklin County and Pittsylvania County Boards of Supervisors should consider mandatory septic pump-outs in the future to improve water quality.
- Dail noted that a lot of the discussion had centered on Franklin County and asked how to get the word about the clean-up plan out to watershed stakeholders in Pittsylvania County. Someone mentioned that the Chatham Star-Tribune is well-read in Pittsylvania County. People in both counties read their weekly papers. Morris Stephenson offered to print anything we wanted in *The Franklin News-Post.* Someone commented that folks in Franklin County read the newspaper cover to cover.
- Scott Martin reported that Franklin County, along with the US Fish and Wildlife Service is working on a Pigg River Watershed Management Plan (WMP). Martin added that the WMP has been endorsed by the Board of Supervisors and the probable next step would be for it to go to the local representatives in Congress.

- Karen Kline asked what percentage of replacement septic systems would be conventional versus alternative systems. Richardson gave a rough ball park figure of seven out of ten new systems would be conventional waste treatment systems. Carter cautioned that it is hard to estimate a percentage.
- Dail mentioned that part of the plan includes continued water quality monitoring within the watersheds. She asked the group to be thinking of locations for the monitoring sites.
- Tony Goff informed the group that in 2006 $370,000 had been allocated by the state for agricultural BMPs in the Pigg River watershed. Only $96,000 has been used to date. The group agreed that word of mouth about the funds would be the best way to publicize the BMP funds.

Reduce runoff of pet waste.

- Dail asked if people walk their dogs at Waid Park. Response was that very few people walk their dogs. There is no leash law in Franklin or Pittsylvania Counties. It would be hard to change people's attitudes to pick up pet waste.
- It was suggested that the kennels, pet breeders, and veterinary offices in the watershed be contacted.
- Someone mentioned that there is no leash law in Rocky Mount and that most pets are "run loose" pets.
- It was also mentioned that Subdivision Deed restrictions would be a good way to encourage picking up after your pets [this would also work for septic system maintenance].
- The group consensus was that a pick-up-after-your-pet campaign would go unnoticed in both counties. The clean-up plan should focus efforts on straight pipes and failing septic systems.

Funding Opportunities:

Does anyone have suggestions on obtaining funding?

Response was that we will have to be creative in trying to get funds.

Steering Committee Representation: Dail explained the role of the Steering Committee and invited anyone interested to serve on the committee. Benham added that the Steering Committee will be asked to provide an in-depth review of the clean-up plan. Dail asked that if anyone was interested in serving to email her (mrdail@deq.virginia.gov).

Follow-up and Next Steps:

Is there anyone missing from the group?

Carter asked that Michael Richardson (VDH) be added to the residential working group. He covers the Figsboro and Snow Creek areas.

Suggestions on location and time for meetings.

- Response was that The Franklin Center is a good location for meetings.
- Time of meeting is okay (6:30pm), one person mentioned that he wouldn't be able to attend Tuesday meetings.

Did we overlook anything?

- Someone asked how meetings are publicized and Dail asked the group what would be the best way to publicize meetings. Response: weekly newspapers would be best, also run on Channel 6, flyers in country stores (e.g., Penhook Mini Market, Carl's), Ruritan Clubs (e.g., Crossroads, Waidsboro), Cattlemen's Newsletter (contact Tony Goff), Rocky Mount Farm Credit (John Lindsey), Cattleman's Association Meetings
- Someone suggested an educational program in the schools (elementary, middle and high school) demonstrating monitoring at different sites. The awarding of scholarships for environmental initiative related to water quality.

- Jim Bier asked if a hard copy of the report on Pigg River and Old Womans Creek Bacteria TMDLs could be placed on a reserve shelf in the library. Dail said that she would follow up on this. Bier offered to coordinate with Dail on this.
- Someone asked if there is money for flyers. Benham answered that it can be written into the plan. He also mentioned that most areas hire a residential technical assistant to assist in implementation of a clean-up plan.
- Raymond Williams mentioned the need to connect folks to the land and help them realize the economic benefit of clean streams and rivers. Williams went on to say that people are more supportive of local agriculture and there's an opportunity to connect the positive effect that clean water has on agriculture.

Minutes from Franklin County Agricultural Working Group Meeting held on October 30, 2008 at The Franklin Center, Rocky Mount, VA:

Attendees: Tony Goff (Blue Ridge Soil and Water Conservation District, BRSWCD), Preston Belcher (farmer), David Cundiff (guest speaker, farmer), Ethan Cundiff (farmer), Garrett Hodges (farmer), Ned Hudson (farmer), Katherine Jordan (Ferrum College), Perry W. Morgan (BRSWCD), Jack O'Connell (National Resources Conservation Service, NRCS), Doug Phillips (Southeast Rural Community Assistance Project, SERCAP), Kathy Smith (BRSWCD), Morris Stephenson (*The Franklin News -Post*), Michael Tabor (BRSWCD), Brian Watson (Virginia Department of Game and Inland Fisheries, VDGIF), Megan Sommers Bascone (DCR), Karen Kline (VT BSE), Mary Dail (DEQ WCRO)

Welcome and introductions: Tony Goff welcomed attendees and each person introduced him or herself.

Overview of the Cleanup/Implementation Plan Development:

- Mary Dail provided a review of the water quality monitoring data and the development of bacteria TMDLs for the watersheds. She presented the required bacteria reductions needed within the watersheds to meet the Water Quality Standards.
- Dail explained the purpose of the meeting was to obtain feedback on agricultural issues that will affect the development of a Cleanup Plan.

Bacteria Reduction Strategies:

Discussion: How to save money, keep herds healthy and have clean water in the Pigg River and Old Womans Creek watersheds

- Goff presented a list of available practices that can be implemented in the Pigg River watershed to reduce bacteria loads from agricultural sources. He also discussed the common practices from the list that are currently being used in the watershed.
- David Cundiff, a beef cattle farmer in the Pigg River watershed who is also a member of the Franklin County Board of Supervisors, spoke on the best management practices (BMPs) that he has used on his farm since 2002. Cundiff spoke of the benefits of fencing cattle out of the ponds and stream on his property. He has not lost any new-born calves from drowning or being stuck in the muddy banks of a pond or stream nor has his herd experienced any water borne diseases or injuries since fencing them from the ponds and stream banks. Cundiff expressed that he wants to keep the Pigg River "as clean as we can and be good stewards of the land" for those living downstream of his farm and also he wants his son "to be able to grow up and have the farm with quality water." Cundiff also mentioned that he is working with the BRSWCD to install a pilot manure handling facility which will allow more control of where cattle manure will be applied to the land.
- Goff then provided more detail on some of the BMPs (i.e., stream exclusion, stream crossings, watering facilities, and grazing land management) that can improve water quality, herd management, and herd health, and also reduce feed costs.
- Jack O'Connell added that without stream fencing the cattle are hard to see, hard to count. With watering systems away from the stream banks the cattle are easier to see and take care of.
- Dail opened the meeting to questions and comments. Doug Phillips asked how cattle would cool off in summer if ponds are fenced. P.W. Morgan responded that the cattle would find shade elsewhere.
- Dail asked Morgan to describe some of the cost-share practices available in the watershed. Morgan replied that the SL-6 practice includes fencing for stream banks and interior fencing for grazing systems. The SL-6 does not include cost-share money for fencing property borders. The WP-4 practice is typically used on dairy farms to manage manure. Morgan stated that Dana Young, civil engineer with NRCS, handles the design of any facility involving manure. The WP-4B practice includes the design of a loafing lot management system. BRSWCD is working on one for David Cundiff now.

- Dail asked if the 35 foot buffer would be a tough sell in the watershed. O'Connell replied that it would only be tough to sell to farmers with pasture that includes lots of tributaries in a "maple-leaf" pattern. He stated that a federal program is a little more flexible for these circumstances.
- Karen Kline distributed a handout with stream lengths and stream fencing estimates along with cost estimates for various BMP practices. Kline asked the group to look at the numbers in the handout and provide feedback either during the meeting, or contact her later (klinek@vt.edu). She then asked about the types of practices that dairy and beef producers may be willing to use in the Pigg River watershed. Morgan mentioned that "pack barns" are something to consider for the watershed. There is federal money and cost-share money available. The pack barn is loose housing, with sawdust bedding on the floor. Morgan visited several dairies in the Harrisonburg area that are using these barns. They can be used for beef or dairy operations. A barn that houses 75 cows would cost an estimated $75,000. O'Connell added that these barns are good for grazing dairies, where farmers would sacrifice some area to put into a shed instead.
- Kline asked the group if any producers in the watershed would be receptive to converting pasture on steeper slopes to forest or allowing a 100 foot stream buffer on steeper pastures. O'Connell responded that the farmers in the watershed would only be willing to give up enough pasture for the 35 foot buffers. Morgan stated that a farm could pay for its own stream fencing and choose the buffer width and type of fencing (e.g., single-strand) and then receive money for other cost-share practices such as hardened crossings.
- Several members of the group stated that the estimated cost for a hardened crossing listed on the handout was too low. The group agreed that the average cost to install a hardened crossing was $1,500 per system.

Funding Opportunities:

- The Virginia Agricultural BMP Cost Share Program
- The Environmental Quality Incentives Program
- Brian Watson presented information on a unique funding opportunity for the Pigg River and Old Womans Creek watersheds, the Landowner Incentive Program (LIP), administered by VDGIF. LIP is similar to the Wildlife Habitat Incentives Program (WHIP) which is offered through NRCS. LIP provides funding for stream restoration and riparian buffer projects to private landowners through a federal grant funded by US Fish and Wildlife Service. The program benefits at-risk aquatic species, such as the Roanoke logperch. Landowners are required to be willing to install at least a 35-foot vegetated buffer along stream to be eligible for funding. The program can be combined with other programs that provide fencing and/or alternative watering systems. Watson showed slides of projects in other states and one currently underway in Virginia. Watson provided his contact information (Brian.Watson@dgif.virginia.gov) and distributed brochures about LIP.

Steering Committee Representation: Dail invited anyone interested to serve on the steering committee. If anyone is interested in serving they can email her (mrdail@deq.virginia.gov).

Follow-up and Next Steps:

- Dail asked the group how they heard about the meeting, most of the farmers responded that they saw the announcement in the FSA newsletter.
- Dail thanked Morris Stephenson for attending the meeting and for his reports covering the Pigg River and Old Womans Creek Cleanup Plan in The Franklin News-Post.
- Dail announced that the group would be notified of the next meeting once the date is set.

Minutes from Pittsylvania County Agricultural Working Group Meeting held on November 6, 2008 at USDA Service Center, Chatham, VA:

Attendees: John Myers (Pittsylvania Soil and Water Conversation District, PSWCD), Bill Huff (resident), Karen Kline (Virginia Tech Biological Systems Engineering, VT BSE), Robin Shields (Pittsylvania County Health Department), Dan Sleeper (Pittsylvania County Administrator), Paula Nash (Virginia Department of Environmental Quality, DEQ), Mary Dail (DEQ)

Welcome and introductions: Mary Dail welcomed attendees and each person introduced him or herself.

Overview of the Cleanup/Implementation Plan Development:

- Mary Dail provided a review of the water quality monitoring data and the development of bacteria TMDLs for the watersheds. She presented the required bacteria reductions needed within the watersheds to meet the Water Quality Standards.
- Dail explained the purpose of the meeting was to obtain feedback on agricultural issues that will affect the development of a Cleanup Plan.

Bacteria Reduction Strategies:

Discussion: How to save money, keep herds healthy and have clean water in the Pigg River and Old Womans Creek watersheds

- John Myers (PSWCD) presented a list of available practices that can be implemented in the Pigg River and Old Womans Creek watersheds to reduce bacteria loads from agricultural sources. He also discussed the common practices from the list that are currently being used in the watershed.
- Myers provided information on some of the BMPs (i.e., stream exclusion, stream crossings, watering facilities, and grazing land management) that can improve water quality, herd management, and herd health, and also reduce feed costs.
- Dail opened the meeting to questions and comments:
- **Question**: Who has oversight over making pasture land into forested land:

  Answer: Cost-share practice FR-3 is available through SWCD. Also, forested buffers can be added around forest or cropland.
- **Question**: Are all of the forested buffers under the same programs?

  Answer: Yes, CREP, continuous CRP (whole county), EQUIP, SWCD BMP practices. Programs include fencing between buffer and cropland or pasture.
- **Question**: Is diversion of water from stream or pond to an alternative watering system permitted?

  Answer: This can be done, but it is not suggested. A well is a better source of water for the system.
- **Question**: What about obtaining water from a spring for the water troughs?

  Answer: Yes, but water from springs usually has to be piped and the pipes easily clog up.
- **Question**: What kind of problems can occur with wells?

  Answer: Problems can occur with wells supplying water to troughs when electricity goes out. Myers recommends putting a gate into the buffered area. If electricity goes out and cattle need water, they will have temporary access to stream. Wells are recommended over other sources discussed (stream, pond, spring) because the water is cleaner. The pressure tank should not be buried; a well house should be built instead.
- **Question**: What about solar power for the well pump?

  Answer: Can be done, but need to think about pumping water on cloudy days or winter when there is not as much sunlight. If a storage tank is added, gravity fed pipes to trough would work. Myers suggests putting water troughs 500-700 feet apart. Cows will graze around water troughs.

- Karen Kline asked the group if landowners would consider converting steep-sloped pastureland to forest. Myers replied that he thinks there are some landowners in the watersheds that would be responsive to this; he's already suggesting the FR-1 BMP cost-share practice to some interested landowners.
- Dail responded to a question about the difference in reductions required for the Stage 1 and final TMDL.
- Dail also responded to a question regarding when water samples were collected in the watershed, are rainfall events targeted. Dail replied that DEQ does not target rain storms or droughts, samples are randomly collected within an appointed time period.
- **Question**: Are bacteria loads coming off of pasture to the stream from surface runoff or permeation?

  Answer: Mainly surface runoff.
- **Question**: Could hay bales be used in the fields to divert water during a runoff event? Water could be diverted to a storage area before entering stream.

  Answer: After some discussion the consensus was that this would not be cost effective, and may not provide much reduction.
- **Question**: Could activated carbon be applied to pasture to adsorb bacteria, using a concept similar to a filter on drinking water sources?

  Answer: Adding carbon to the soil could lead to nutrient problems.
- **Question**: What happens when the implementation plan (IP) is finished?

  Answer: The plan is presented to the general public at a public meeting. Unlike a TMDL report, an IP does not have to be approved by EPA. Normally, once the plan is complete, DEQ will publish it, and then implementation will begin. The Pigg River and Old Womans Creek Clean-up Plan is somewhat different because thanks to the SWCDs efforts, implementation has already begun. The steering committee will need to discuss whether they want to keep meeting after the IP is finalized.

Follow-up and Next Steps: Dail asked the group for their preference of times for a steering committee meeting. General consensus was that a meeting in early December would be good.

Minutes from Steering Committee Meeting held on December 17, 2008 at The Franklin Center, Rocky Mount, VA:

Attendees:

Welcome and introductions: Mary Dail welcomed attendees and each person introduced him or herself. Dail then provided a brief review of the Pigg River and Old Womans Creek TMDL study conducted in 2006. Next she provided a brief description of the components of an implementation plan that are required by the state of Virginia.

Status report on working group meetings:

- Jared Webb reviewed the residential working group report with the steering committee. The report to the steering committee was a summary of the minutes from the residential working group meeting held on 8/14/08.
- Tony Goff reviewed the Franklin County agricultural working group report with the steering committee. The report to the steering committee was a summary of the minutes from the Franklin Co. agricultural working group meeting held on 10/30/08.
- John Myers reviewed the Pittsylvania Co. agricultural working group report with the steering committee. The report to the steering committee was a summary of the minutes from the Pittsylvania Co. agricultural working group meeting held on 11/6/08.

Review of Implementation Scenarios:

- Karen Kline provided a proposal of the number of agricultural and residential BMPs needed to meet staged water quality goals. Kline began with a table of implementation actions identified by the steering committee and working groups throughout the planning process. She explained that the table shows primary (on the ground practices) and educational components to be included in the plan. In reviewing the table, Kline showed which practices had funding attached to them through the state cost share program.
- Kline reviewed the estimates of the type and quantity of agricultural practices needed to meet the water quality goals and the associated cost estimates. The steering committee offered some input on individual practice costs and agreed that the numbers given for these practices were good average estimates except for the estimates for hardened crossings and pack barns. A hardened crossing includes the trail leading up to it and the steering committee suggested an estimated cost of $6,000. PW Morgan mentioned that a 70-cow pack barn with no concrete pad had recently been planned for the Blue Ridge SWCD at a cost of approximately $70,000. He offered to send more information to Kline via email after the meeting. (*Follow-up: email from Morgan to Kline on December 19, 2008 described an NRCS plan for a pack barn with an average cost per square foot of $11.92, and average cost per animal of $1,192.00. This design is for a loose housing structure with 100 square foot of space per full size cow and does not include grading, gutters, or downspouts.*)
- Kline reviewed the estimates of residential practices needed to meet the water quality goals and the associated cost estimates. Dail noted that Tim Baker (VDH) could not be at the meeting but wanted the minutes to reflect that VDH believes the estimate of failing septic systems in the watersheds is too high. Dail responded that the estimates being used were approved for the TMDL and are conservative so that we can be the most protective of the water quality. The steering committee agreed that the cost estimates for the residential BMPS were appropriate but added that the cost estimate for a conventional septic system was for a gravity fed system. The committee felt that only 30% of the conventional systems would be gravity fed, 70% would need a pump which would have an average cost of $6,000 per system. It was noted that the Southeastern Rural Community Action Program (SERCAP) may be a source of funds for assisting low income folks with septic system installations or repairs.
- Kline suggested that estimates of need and costs for technical assistance and staffing be calculated from similar projects in Virginia. She will provide estimates for review at the next steering committee meeting.

Establish implementation and water quality milestones: Kline asked for suggestions for a timeline for the implementation project. She noted that similar projects in Virginia have proposed a 3-stage timeline with

the first stage being five years and a water quality goal of 10.5% or less violation rate of the bacteria water quality standard. This is important since a stream can be delisted once it achieves below a 10.5% violation rate. Kline proposed a second stage of five to eight years to meet 100% of the implementation goals (installation of all implementation measures), and then an additional five years to achieve a 0% violation rate of the bacteria water quality standard. The committee consented to a suggested timeline as follows: Stage 1 – 5 years; Stage 2 – 5-8 years; Stage 3 – 5 years.

Set date for next Steering Committee meeting and public meeting: Dail suggested that the final public meeting be held in February. The steering committee will have an opportunity to review the implementation plan before the public meeting. Dail asked the group for their preference of time for the next steering committee meeting. General consensus was that an evening meeting in late January or early February would be good.

APPENDIX B. GLOSSARY OF BMP AND OTHER CONTROL MEASURE DEFINITIONS

Adaptive fencing: This term refers to livestock exclusion fencing that is typically installed on a voluntary basis using less expensive poly-wire fencing, and is typically installed with a smaller buffer width, resulting in more available grazing acreage.

Alternative water system: A structural practice that will provide an alternative water source for livestock to discourage animal access to streams. Cost-sharing and/or tax credits may apply to construction or deepening of wells; development of springs or seeps, including fencing of the area where needed, to protect the development from pollution by livestock; construction or repair of dugouts, dams, pits, or ponds; and the installation of pipelines, storage facilities, cisterns, troughs and artificial watersheds.

Bioretention filter: A depressed landscaping area that is allowed to collect runoff so it percolates through the soil below the area into an underdrain, thereby promoting pollutant removal.

Fencing: A constructed barrier to livestock, wildlife or people. Standard or conventional (barbed or smooth wire), suspension, woven wire, or electric fences shall consist of acceptable fencing designs to control the animal(s) or people of concern and meet the intended life of the practice.

Hardened crossing: A controlled stream crossing for livestock and/or farm machinery in order to prevent streambed erosion and reduce sediment.

Improved pasture management: This practice consists of a series of measures to improve vegetative cover on, and reduce bacteria loading from, pasture areas and may include soil testing, application of lime and fertilizer based on soil testing results, maintenance of a 3-inch minimum grass height through the growing season except for droughts, mowing to control woody vegetation, and chain-harrowing to break-up manure piles after livestock are moved from field.

Livestock exclusion: Excluding livestock from areas where grazing or trampling will cause erosion of stream banks and lowering of water quality by livestock activity in or adjacent to the water. Limitation is generally accomplished by permanent or temporary fencing. In addition, installation of an alternative water source away from the stream has been shown to reduce livestock access.

Livestock exclusion fencing: This practice consists of installing fencing, both temporary and stream exclusion (permanent), for grazing distribution and to restrict stream access in connection with newly developed watering facilities. State and federal cost-sharing requires that the stream exclusion fence be placed a minimum of 35 feet away from the stream, except as designed in areas immediately adjacent to livestock crossings and controlled hardened accesses.

Livestock exclusion buffers: In the implementation plan, this term is used to differentiate the filtering benefits of the buffer, as opposed to the removal of livestock and their directly deposited bacteria loads from the stream. Removal of the livestock has an immediate effect in removing bacteria loads, while the buffer mitigates loading from surface runoff during storm events.

Loose cattle housing facility: Loose cattle housing facilities, or winter feeding facilities, are specially designed to allow for the feeding of livestock in combination with the safe storage of manure, and to prevent contamination of nearby water corridors and streams. They are also designed to provide shade in the summer and wind protection in the winter. Loose housing facilities are typically sized for individual farms, based on number of head of livestock fed through the winter; are designed to hold 5-7 days of feed; and to store waste for at least 120 days. This practice may also include the following components: gutters & downspouts redirect runoff, livestock watering facilities, heavy use area protection around the facility, and all-weather access roads to the structure.

Manure storage facility: This practice consists of a planned system designed to manage liquid and solid waste from areas where livestock and poultry are concentrated. The storage allows for the farm operator to apply the manure on fields during optimum times of the year, and increases the die-off of bacteria in the animal waste.

Residential pet waste education program: This is an educational program conducted to demonstrate how homeowners can responsibly manage fecal wastes from their pets, both at their own homes, and when taking their pets for walks in public areas. The program also usually includes signage describing water quality concerns related to pet waste and pet waste collection bag dispensers and receptacles in high pet traffic areas, such as in parks and along greenways.

Reforestation of pastureland: This practice consists of planting trees (hardwoods and/or conifers) on land currently used as cropland or pastureland in order to make a permanent land use conversion to forest, so as to more effectively control the soil and nutrient loss from surface runoff, thus improving water quality. As part of the practice, a permanent vegetative cover is to be established on gullied or eroded areas and shall be maintained until trees provide a protective canopy.

Riparian forest buffer: A protection method used along streams to reduce erosion, sedimentation, and the pollution of water from agricultural nonpoint sources. An area of trees and shrubs 35 – 300 feet wide located up gradient, adjacent, and parallel to the edge of a water feature.

Riparian grass buffer: Grass filter strips are vegetative buffers that are located along the banks of water courses to filter runoff, anchor soil particles, and protect banks against scour and erosion. The strips also improve water quality by filtering out fertilizers, pesticides, and microorganisms that otherwise might reach waterways. In addition, grass filter strips along streams serve as environmental corridors.

Septic system pump out: This preventative control measure consists of periodic maintenance of septic tank systems by having the tank pumped to remove solids and to inspect the septic tank. This practice also allows for the identification of systems which are not functioning properly. The practice also may include inspection of the distribution box to determine if the effluent is being properly distributed to the drainfields and the system is functioning in accordance to design.

Septic system repair: This measure consists of the correction of a malfunctioning on-site sewage disposal system to remove the presence of raw or partially treated sewage on the ground's surface, or in adjacent ditches or waterways, or in ground water.

Septic system, alternative: An alternative on-site waste treatment system is needed to correct a malfunctioning on-site sewage disposal system or to replace an identified straight pipe in

situations where the installation/replacement of a septic tank system cannot be permitted. Alternative systems may include the following: aerobic treatment units, low pressure distribution systems, drip distribution systems, sand filters, elevated sand mounds, constructed wetlands, peat filters, vault privies, incinerator toilets, and composting toilets.

Septic system, new: This control measure consists of the installation of a septic tank system to replace an identified straight pipe which delivers sewage directly to a stream, pond, lake, or river or an installation to correct a malfunctioning on-site sewage disposal system. Cost-sharing may include the pump out and removal of solids from the malfunctioning septic tank, the installation of a septic tank and subsurface drainfield components, and the re-stabilization of disturbed areas by planting seed.

Septic system, new with pump: Same as for a new septic system, with the inclusion of a pump as a primary component to move waste to a higher elevation.

Sewer hookup, new: This practice consists of connecting a malfunctioning on-site sewage disposal system to public sewer, or replacing an identified straight pipe by a connection to public sewer. Cost-sharing may be authorized for the connection fee, which is the fee allowing the dwelling to be connected to the public sewer system, for the construction cost associated with connecting the dwelling to a sewer line, for re-stabilization of disturbed areas, and for the pump-out and removal of solids from the septic tank.

Street sweeping: The practice of passing over an impervious surface, usually a street or a parking lot, with a vacuum or a rotating brush for the purpose of collecting and disposing of accumulated debris, litter, sand, and sediments. In areas with defined wet and dry seasons, sweeping prior to the wet season is likely to be beneficial; following snowmelt and heavy leaf fall are also opportune times.

APPENDIX C. BMP CODES AND PRACTICE NAMES

CP-21: CREP filter strip (rental only)
CREP: Conservation Reserve Enhancement Program
CRFR-3: Riparian forest buffer
CRP: Conservation Reserve Program
FR-1: Reforestation of erodible cropland or pastureland
RB-1: Septic tank pump out
RB-2: Connection of malfunctioning On-site Sewage Disposal System or straight pipe to public sewer
RB-3: Septic tank system repair
RB-4: Septic tank system installation/replacement
RB-4P: Septic tank system installation/replacement with pump
RB-5: Alternative on-site waste treatment system
SL-6: Grazing land protection systems
SL-6B: Alternative water system
SL-11: Permanent vegetative cover on critical areas
WP-4: Animal waste control facility
WP-4B: Loafing lot management system
WP-8: Relocation of confined feeding operations from environmentally sensitive areas
WP-2T: Stream protection systems
WQ-1: Grass filter strips
WQ-4: Legume cover crop

APPENDIX D. DOCUMENTATION FOR PR&OWC BMP MODELING

Basis for BMP Extents

- Livestock exclusion: stream lengths in or adjacent to NLCD pasture areas were delineated using GIS and separated into perennial and intermittent categories (lin. ft.). After consultation with local SWCD and NRCS personnel, 30% of intermittent streams in addition to all perennial streams were considered the length requiring fencing. Adaptive fencing was estimated as the appropriate means for livestock exclusion for 25% of the total length. Associated buffer zones were calculated as 35 feet for typical cost-shared stream fencing (acres).
- Hardened crossings: estimated as 1 per 2,000 linear feet of stream exclusion fencing for a WP-2T system (55).
- Alternative water systems: estimated as 3 per stream exclusion fencing system (SL-6 or WP-2T) by local SWCD personnel (1,350).
- Reforestation of pastureland: estimated as 10% of the pasture area in Pittsylvania County (649 acres).
- Improved pasture management: estimated as being needed on 99.8% of the available pasture acreage, in order to meet the pasture bacteria target reductions (48,286 acres).
- Loose cattle housing facilities: estimated based on number of cattle needing to be housed (9,686).
- Septic system repairs: estimated as 80% of all failing septic systems by VDH personnel. Failing septic systems were enumerated in the TMDL study as 27% of the population using septic systems (1,658).
- Alternative waste treatment systems: estimated as 30% of all failing septic systems needing replacement and 10% of straight pipes needing replacement by VDH personnel (125).
- Conventional septic systems: estimated for 90% of households currently with straight pipes and 20% of all failing septic systems. The number of straight pipes in the watershed was estimated in the TMDL study as 0.2% of the non-sewered population (87 without pumps and 216 with pumps).
- Residential pet waste education program: estimated reductions due to a pet waste program were estimated based on the number of pets in the watersheds (9,094 in Pigg River watershed and 194 in Old Womans Creek watershed).
- Bioretention filters: used as control measures of last resort. Estimates of their extents were based on areas needed to achieve pasture bacteria load target reductions in the Snow Creek and lower Pigg River watersheds (156 acres).

Basis for Acres Benefitted (AB)

- Grass and forested riparian buffers: estimated as benefitting an upstream area equal to 4 times the buffer area based on conversations with DCR.
- Bioretention filters: generally treat an area 20 times its design area, as indicated by LID design spreadsheets found at www.lid-stormwater.net/bio-sizing.htm, where default device areas of 5% of the deign areas are commonly used.

The control measures that reduce available bacteria loads on the surface of the land (loose housing facilities) were simulated first to adjust and reduce the unit-area bacteria load (UAL) that could then be reduced by other field-based control measures.

Basis for Bacteria Load Reduction Calculations

Bacteria load reductions were generally calculated either as a reduction in the overall unit-area load (UAL) of bacteria applied to an individual land use, or as an area of a given BMP, with an associated effectiveness estimate for an individual control measure. Reductions from land use changes were simulated as the difference in the UALs between the two land uses, and practices associated with additional filtering benefits were simulated as affecting some multiple of the buffer area.

- Livestock exclusion fencing:
  % of total stream length * direct deposit load
- Livestock exclusion buffers:
  $[(UAL_{pasture} - UAL_{forest}) + 4 * UAL_{pasture}]$ * BMP area * BMP efficiency
- Reforestation of pasture areas:
  $(UAL_{pasture} - UAL_{forest})$ * BMP area
- Improved pasture management:
  $UAL_{pasture}$ * BMP area * BMP efficiency
- Loose housing facility: cfu/animal-yr * no. of animals * BMP efficiency
- Pet waste program:
  % of watershed pets * residential bacteria load * % of residential load due to pets * BMP efficiency
- Bioretention filters: 20 * $UAL_{pasture}$ * BMP area * BMP efficiency